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TWENTY-SEVENTH ANNUAL REPORT

1947

SOUTHERN FOREST EXPERIMENT STATION
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New Orleans, La.

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TWENTY-SEVENTH ANNUAL REPORT

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1947

INTRODUCTION

The revival of Flood Control Surveys was the most important change in the program of the Southern Forest Experiment Station in 1947. Prior to the war Flood Control Surveys constituted a major part of the Station program. During 1943, however, this work was stopped completely. Partially finished reports and studies were laid aside pending the time when conditions would permit their completion. Finally, in late 1947, funds became available and recruiting for the revived surveys began. At the close of the year a skeleton staff had been assembled and the work was being picked up where it was left in 1941.

Some adjustments in the Station program after July 1947 were necessitated by reduction in Forest Survey and Forest Utilization Service funds. The rate of progress for the Forest Survey was reduced and Forest Utilization Service activities were curtailed.

Results obtained in 1947 and plans for 1948 are briefly presented in this report. Both results and plans are classified according to technical subject matter. A brief account is presented on the status of experimental forest development at each branch.

RESULTS

FOREST MANAGEMENT
(Including Forest Influences)

Silviculture

Thinnings and growth in young stands

Loblolly and shortleaf pines.--A thinning study on the Crossett Experimental Forest has demonstrated that old-field stands will reproduce themselves after thinnings reduce basal areas to 50 to 60 square feet per acre. Reproduction will develop satisfactorily under basal areas as high as 80 to 85 square feet per acre, but development of the reproduction is not so good as where the stand density is lower. There are about one million acres of old-field pine in the territory of the Crossett Branch to which this information directly applies and many thousands of acres of the same general type elsewhere in which these results are indicative at least.

A thinning study at Urania, Louisiana, has indicated methods that will produce the highest quality and the largest volume growth. Greatest cubic volume of pulpwood was produced by thinning from below, while the highest quality production of sawlog material resulted from thinning from above. This is important, in that property owners interested in volume production, principally pulpwood producers, may wish to thin their stands differently from sawmill operators or owners desiring to produce high-quality logs as an end product.

Longleaf pine.--Three one-half-acre fully stocked longleaf pine growth plots at McNeill, Mississippi, measured in 1928, 1933, 1938, and 1947, show interesting results. The stands originated from natural seeding in 1903. One plot was burned annually for 10 years by winter fires in the period 1923 to 1933. The other two plots were not burned during this period. Despite the lack of thinning, these plots are making good growth, thus indicating the capacity of longleaf pine to grow well up to 40 years in relatively dense stands. On a conservative estimate of current stumpage value, average annual returns since 1903 have amounted to $2.67 per acre for the unburned-ungrazed, $2.63 per acre for the unburned-grazed, and $2.32 for the burned-grazed plots. Apparently, annual burning for a 10-year period early in the life of the stand had a deleterious effect which reduced average annual return by 30 to 35 cents per acre per year.

Table 1.--Growth and yield per acre of fully stocked stands of 44-year-old longleaf pine

Year	Number of trees	Average d.b.h.[1]	Merch. volume[2]	Merch. basal area[2]	Average annual growth	Stumpage value 1947[3]
		Inches	Cu.ft.	Sq.ft.	Cu.ft.	Dollars
			Unburned-ungrazed plot			
1928	832	2.9	168	21.2	6.7	
1947	644	6.3	3286	129.6	74.5	117.42
			Unburned-grazed plot			
1928	712	3.0	148	16.2	5.9	
1947	584	6.5	3126	130.2	71.0	115.38
			Burned-grazed plot[4]			
1928	710	3.1	218	23.6	8.7	
1947	486	6.3	2408	99.2	54.7	102.02

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[1] For all trees 0.6 inches d.b.h. and larger at the time of measurement.

[2] Includes only trees 3.6 inches d.b.h. and larger.

[3] Based on saw timber at $12.00 per M, International 1/4-inch scale, poles at 25 percent of delivered price rough peeled, and pulpwood at $1.50 per cord.

[4] Fired annually each winter for 10 years (1923-1933).

A growth study on the Harrison Experimental Forest shows the rapid rate at which understocked longleaf pine stands approach "normality" or full stocking as given in the southern pine yield tables. Table 2 gives the data for three plots that were understocked at establishment but have grown 30 to 208 percent faster in volume per acre than fully stocked stands of comparable age and site quality.

Table 2.--Increase in stocking with age in longleaf pine

Date	Total age	Trees per acre	Volume per acre (i.b.)	Percentage of normal stocking	Periodic annual increment: Volume per acre, i. b.	Periodic annual increment: Percentage of normal growth
	Years	No.	Cu. ft.	Pct.	Cu. ft.	Pct.
			Plot 1--Site index 66 feet			
1938	33	101	1029	46.5		
1942	37	101	1403	56.0	93.5	139
1947	42	101	1849	63.8	89.2	130
			Plot 2--Site index 80 feet			
1938	23	328	739	35.9		
1942	27	328	1504	59.7	191.2	210
1947	32	318	2367	76.6	172.6	182
			Plot 3--Site index 70 feet			
1938	41	368	2920	91.5		
1942	45	363	3887	109.5	241.7	309
1947	50	348	4761	120.5	174.8	221

Improvement of depleted stands

Loblolly-shortleaf-hardwood type.--Results of a release cutting study at Crossett, Arkansas, show that removal of low-grade hardwoods from pine-hardwood stands is one of the most effective forestry measures a landowner can take. The following table summarizes the most important data obtained 7 years after low-grade hardwoods in different amounts were removed from the mixed pine stands. .

Table 3.--Effects of removal of low-grade hardwoods on the release of pine reproduction

(Figures are per acre)

Item	Size of hardwoods removed, 1939		
	Over 6 inches d.b.h.	Over 2 inches d.b.h.	Over 5 feet high
Number hardwoods removed, 1939	22	137	186
Number pines left, 1939	1442	1271	1589
Actual profit or loss, 1939[1]	+$0.13	-$1.41	-$2.35
Estimated cost, 1947 rates[2]	$ .52	$1.52	$1.79
Number pines, 1946:			
Seedlings and saplings			
0 - 0.5 inches d.b.h.	961	1154	1485
0.6 - 3.5 inches d.b.h.	491	445	758
Trees 3.6 inches d.b.h. and larger	68	147	197
Total	1520	1746	2440
Total not overtopped	306	552	763

[1] Hardwoods 6 inches d.b.h. and larger were used for chemical wood.

[2] Assuming no utilization; hardwoods cut or girdled.

Where only hardwoods larger than 6 inches d.b.h. were removed, stocking of pine is now about 60 percent of the amount considered desirable. The other two areas treated are essentially fully stocked with pine, even though the crown canopy is not yet 100 percent pine. In each case, there is an excellent return for the moderate investments that were made.

Hardwoods--mostly of low grade and with very limited markets--occupy one-third to one-half of the area of mixed stands in the South. Hardwood removal is needed on about 6 million acres in south Arkansas and north Louisiana alone. These test results are highly significant because they show that where markets for poor hardwoods are not available, cutting and girdling costs can soon be repaid by increased growth of pine, particularly where pine is abundant and needs only adequate space to grow rapidly.

In a study of cutting and girdling costs made at Crossett in 1947, 178 hardwoods per acre were treated. Trees averaged 5 inches d.b.h. and ranged from 1 to 20 inches d.b.h. Trees 1 to 5 inches d.b.h. were cut and those 6 inches and up were girdled. The cost was $3.31 per acre. Ninety-three trees per acre were treated for $1.71. The hardwoods in this study averaged considerably larger than those in the release cutting study started in 1939.

At the East Texas Branch, a study of four methods of improvement and release cutting in a typical depleted pine-hardwood stand was started in 1947. The following costs per acre were determined:

Table 4.--Costs of different stand improvement methods in pine-hardwood stands in east Texas in 1947

Treatment	Stems cut	Basal area removed	Labor	Cost
	No.	Sq. ft.	Man-hrs.	Dollars
1. All hardwoods 7.6 inches d.b.h. and larger girdled	37	29.2	1.61	0.97
2. Selected hardwoods 1.6 to 3.5 inches d.b.h. hinge-cut	22	2.3	1.79	1.07
Selected hardwoods above 3.5 inches girdled	34	25.8		
Total	56	28.1	1.79	1.07
3. All hardwoods 1.6 to 7.5 inches d.b.h. poisoned	217	17.8	5.48	[1]4.29
All hardwoods above 7.5 inches d.b.h. girdled	52	36.2	2.90	1.74
Total	269	54.0	8.38	6.03
4. All hardwoods 1.6 to 3.5 inches d.b.h. hinge-cut	118	11.3	3.21	1.93
All hardwoods above 3.5 inches d.b.h. girdled	57	37.1		
Dense patches of brush spot-burned	...	...	2.62	1.57
Total	175	48.4	5.83	3.50

[1] Includes cost of Ammate at 13.5 cents per pound. Ammate crystals were applied in notches near the ground.

As would be expected, there is a strong relationship between basal area treated and labor required. The comparatively high labor requirements for Treatment 3 are largely the result of the great density of brush and vines, which hindered application of Ammate at the bases of the trees. It will be determined later whether the extra cost of poisoning is repaid by better control of hardwoods and increased growth of pine.

At the Birmingham Branch, removal of low-grade hardwoods from pine-hardwood stands generally can be done commercially at a profit because of the excellent market for mine props, ties, and timbers. A study of three different intensities of improvement and release cutting is now under way there. Removal of merchantable but low-grade hardwoods will return a small net profit in even the most intensive treatment after the cost of girdling culls is deducted. Intensive stand improvement and release will undoubtedly produce excellent results here because nearly one-half the area is already stocked with desirable reproduction, mostly of shortleaf pine. There is also an adequate number of seed trees. Exact cost figures applicable to this area will be forthcoming as this study progresses.

Longleaf pine type.--A small study at the Brewton Branch, in cooperation with a lumber company, shows the comparative costs of three methods of eradicating scrub oaks on longleaf pine land. Pulling up the trees with a tractor cost 2.8 cents per tree, or $9.91 per acre for 354 trees. Cutting with an ax (a saw was used for the larger trees) cost 0.5 cents per tree, or $1.28 per acre for 233 trees. Poisoning with Ammate (ammonium sulfamate) crystals cost 1.2 cents per tree, or $4.62 per acre for 378 trees. In each case, the trees averaged about 2.5 inches d.b.h. Pulling was not only very costly but also ineffective, since about one-half of the trees sprouted in 1947 after treatment in 1946. It remains to be seen whether the extra cost of the poisoning--roughly equivalent to the cost of the Ammate--will be repaid by greater effectiveness. It is likely that the extra cost will be justified, since the cut trees are certain to sprout profusely, whereas the poisoned trees should sprout very little.

Upland hardwood type.--At the Ozark Branch, exploratory tests of Ammate applied to trees and sprouts of blackgum, dogwood, persimmon, and post and blackjack oaks show promising early results. The most interesting and potentially useful result so far is that entire clumps of 10 to 20 blackgum sprouts and small trees arising from the same root system apparently can be killed by cutting only two or three of the outer stems and immediately applying Ammate crystals to the stumps.

Bottomland hardwood type.--At the Delta Branch, in small tests with bitter pecan (water hickory), 100 percent of the sprouts treated were killed by a 61.5 percent solution of sodium arsenite[1] applied to freshly cut stumps. Ninety percent were killed by a 32.5 percent solution of Ammate[2] applied the same way. Costs were 1 cent per sprout clump for sodium arsenite and 1/2 cent for Ammate. Sprouts were cut with a saw. This left a flat, slightly rough surface which retained Ammate very well. If sprouts had been cut with an ax, costs would be about the same for both poisons, for more Ammate would have been needed to wet the smooth, slanted surface left by the ax stroke.

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[1] Eight pounds of white arsenic plus 2 pounds of caustic soda in 3 quarts of water.

[2] Four pounds per gallon of water.

When sprouts too small for stump treatment were sprayed with the Ammate solution, 95 percent of the treated stems were killed. The cost was 14 cents per sprout clump. Trees too large to cut with only one or two ax strokes were killed by the solution of sodium arsenite applied in frills at convenient chopping height. Every treated tree died. Ammate solution or crystals applied in frills only killed 40 to 50 percent of the bitter pecan trees.

(See page 44 for further information on control of scrub oak.)

Silviculture of commercial stands

Loblolly-shortleaf-hardwoods type.--In east Texas, damage from a severe ice storm in January 1947 was measured on a series of methods-of-cutting plots established in a commercial stand in 1937-38. In all, only 6 percent of the trees were seriously damaged, mostly with stems broken below the crown or in the lower one-third of the crown. Twenty-nine percent of the trees were slightly damaged. Loblolly was damaged somewhat more heavily than shortleaf, and in both species damage was greatest in the intermediate and especially the suppressed crown classes. Damage was greatest where the cutting was to an 8-inch stump diameter, intermediate (mostly confined to suppressed trees of little value) in selectively cut plots, and least in shelterwood cuttings that left about thirty vigorous trees per acre. These findings indicate that the methods of cutting most desirable from the standpoint of sustained production and profit are also least susceptible to ice damage.

Bottomland hardwood type.--A permanent sample plot established and marked for cutting in the overcup oak-bitter pecan type in the Mississippi Delta provides interesting information on the forests of this region. The trees present were classified as either growing stock (worth leaving for further growth) or overburden (not worth leaving for further growth and hence to be removed as soon as possible).

Table 5.--Volumes per acre in commercial and non-commercial grades, overcup oak-bitter pecan type

Classification	Commercial grades	Non-commercial but usable	Total
		Bd. ft. (Doyle)	
Growing stock	1607	209	1816
Overburden			
Fair to good quality	2149	729	2878
Sound and rotten culls	152	698	850
Total	3908	1636	5544

By volume, the growing stock is 53 percent overcup oak, 27 percent willow oak, 8 percent bitter pecan, and 12 percent in nine miscellaneous species. It consists of 145 trees per acre 1 to 32 inches in d.b.h., of which only 10.7 trees per acre are 12 inches d.b.h. and larger. Total basal area of the growing stock is only 35.2 square feet per acre; there is 47.3 square feet in the overburden.

In the last 10 years, the growing stock increased only 51 board feet per acre per year. It is estimated that in the 10 years following cutting growing stock will increase 92 board feet per acre per year, or reach a volume of 2,530 board feet per acre in commercial grades. Growth should increase considerably as a result of cutting, but the total volume per acre will not be sufficient to support even a cutting for domestic use for 12 to 15 years. It will be about 25 years before another commercial cutting can be made under sound forestry principles. Since the next commercial cutting is so far away, it is unwise to retain mature high-grade trees in the present cutting. This reouires removal of a few trees which in a shorter cutting cycle should be left as growing stock. The disadvantage in harvesting these trees is partly offset by the increase in immediate return, the increase in space available for reproduction, and the accelerated growth of the remaining stand.

Eastern redcedar type.--(a) Growth and yield. Average annual diameter growth of dominant eastern redcedar (*Juniperus virginiana*) in the Arkansas Ozarks was determined by measurements in 91 natural stands. The results obtained are presented in Table 6.

Table 6.--Average annual diameter growth of dominant eastern redcedar

Site class	Open understocked stands	Dense well-stocked stands	Closed overstocked stands
	- - - - -	- Inches -	- - - - -
II. Soils over 20 inches in depth	0.32	0.32	0.15
III. Soils 10 to 20 inches in depth	.18	.17	.10
IV. Soils under 10 inches in depth	.14	.12	.09

Board-foot and fence post yields of well-stocked natural stands are given in Table 7.

The pH of soil samples collected in each of the 91 natural stands varied from 4.8 to 7.8. Contrary to many common opinions, neither acidity nor alkalinity seems to have much influence on the growth and distribution of eastern redcedar in the Arkansas Ozarks.

Table 7.--Yield per acre of well-stocked natural stands of redcedar

Site class and age of stand		Yield: Fence posts	Yield: Sawlogs
		No.	Bd.ft., Int. 1/4-inch rule
II.	20-28	1200	
	35-40		5500
III.	20-30	1000	
	40-50		4500

(b) Management of natural stands. A study has been started to compare two methods of cutting in a well-stocked redcedar stand on an average site (III) in the Ozarks:

1. Present commercial practice. Consists of removing all merchantable trees at one time. Low-grade hardwoods and cull cedar are not removed.

2. Combination harvest cut, improvement, and thinning. Consists of removing all mature, poorly formed, and defective trees; thinning of remaining sound but immature cedar to an average spacing equivalent to about one-half of their height; and girdling all competing low-quality hardwoods.

The net return per acre under the present commercial liquidation practice was found to be $50, including margin for profit and risk. The return from the partial cut was $40.50 per acre when computed on the same basis. However, 15 to 25 years will be required before the liquidated area will yield a crop, while another though smaller cut can be expected on the partially cut area in 5 years and at similar intervals thereafter.

Natural regeneration

Loblolly and shortleaf pines.--One of the most important and controversial problems in the loblolly-shortleaf-hardwood type is the effect of size and character of overhead openings on the survival and growth of pine seedlings. The latest observations on a study installed on the Crossett Experimental Forest show that pine seedling height growth and survival is best in openings of 1/30-acre or more. Dominant pine seedlings, when overtopped by pine, hardwood, or both pine and hardwood, are respectively 62, 42, and 34 percent of the height of open-grown pine seedlings at the age of 8 years.

The higher the canopy level of the overtopping trees, the better are seedling height growth and survival. Crown densities of less than 30 percent resulted in the best seedling height growth. Pine seedlings made better growth when overtopped by pine than when overtopped by hardwoods. This difference was especially marked in heavy stands. A high overstory of pine in selectively cut forests usually admits enough side light to permit reasonably good growth of reproduction. Pine seedlings will usually start under any kind or degree of overstory, but if they are to survive and grow well, it is essential that the overstory be opened up and hardwoods reduced to a subordinate position.

Further information on the effect of methods of cutting, as well as burning, on the amount of pine reproduction has also been obtained at Crossett. The cutting methods used were: (a) selection, (b) shelterwood, (c) clear cut for sawlogs, and (d) clear cut for all commercial material larger than 6 inches d.b.h. The first series of plots using these cutting methods was established in 1937.

The reproduction obtained on these plots was described in the 1946 annual report. A second series of plots was established in 1942 and the reproduction present on this second set in 1946 is shown in the following table.

Table 8.--Established pine reproduction in 1946 following cuttings made in 1942

Method of cutting	Pine seedlings per acre
Selection	1,124
Shelterwood unburned	3,500
Shelterwood burned	1,625
Clear cut (for sawlogs)	1,081
Clear cut (all) unburned	2,005
Clear cut (all) burned	942

The set of plots established in 1937 has better reproduction because it benefited from the bumper seed crop of 1939. The set established in 1942 reproduced mainly from the fair seed crop of 1942. Hardwood competition has been somewhat more serious on the second set, which was established primarily in second-growth stands, whereas part of the first set of plots was established in old-field stands. Nevertheless, results from the two sets of plots are generally similar. The unburned shelterwood has the most reproduction in both cases.

Burning resulted in fewer pine seedlings than are present on the unburned plots, but those on the burned plots are more vigorous. Adequate reproduction is present on the shelterwood and unburned clear-cut (all) plots, which, of course, need to be completely reproduced. Reproduction on the selection and clear-cut (for sawlogs) plots is concentrated for the most part in the openings, as would be expected.

Longleaf pine.--During 1947 exploratory studies were started at the Gulfcoast Branch to obtain more exact information about longleaf seed production and seedling establishment and behavior. These studies were pointed toward a better understanding of the problem of getting longleaf out of the grass as quickly as possible.

(a) Seed production. The 1947 longleaf seed crop was without question the heaviest that has fallen in the Gulfcoast province since the bulk of the virgin timber was removed. Spot checks on a few old-growth trees for which counts were available in 1935 indicate that more cones were produced on the same trees in 1947 than in the recognized "superlative" crop of 1935. In addition, large numbers of second-growth trees have come into cone-bearing age and size in the last 12 years.

The September 19, 1947, hurricane that swept through the Gulfcoast territory knocked down about 15 percent of the second-growth cone crop. The loss ranged from 2 to 65 percent of the cones on individual trees examined. The more exposed trees generally suffered the heaviest loss. For the most part, the hurricane-felled cones were of little value because seed was not dispersed even in the few instances where cones were ripe enough to open. The bulk of the seed spoiled in the cones, which remained closed after they fell to the ground.

Evidence is beginning to accumulate that some longleaf pine trees are definitely more prolific seed producers than others. Certain trees have managed to bear some cones every year for the past several years. Site unquestionably influences seed production. The heaviest-bearing (631 cones) second-growth longleaf pine tree observed in 1947, however, stood on the dry edge of an actively eroding wash.

Four trees that have been fortuitously manured for several years on the Harrison Experimental Forest have borne fair to heavy crops during each of the past 5 years, and a fair crop appears to be developing for 1948. Although the evidence is sketchy, it is in agreement with previous tests on the effect of manuring on cone production. This fact suggests the possibility of stimulating seed production by using fertilizers in understocked stands or on a select number of potentially good seed producers following cutting. It emphasizes also the desirability of paying close attention to local soil-site conditions in selecting seed trees.

No evidence was uncovered to run counter to the generally observed fact that second-growth trees in crowded stands bear few or no cones. At the same time, enough existing cone bearers were found, even under crowded conditions, to suggest that light cone-bearing trees would develop into inherently heavy producers if released, and therefore that the seed-bearing potential of trees reserved for regenerating the stand after the final harvest cut should be strongly considered.

Heavy scorching of the tree crowns by fire in the fall, winter, and spring preceding maturity of cones may wipe out the entire cone crop in the scorched portion of the crown. A small test was made in October 1947 to determine the reduction in seed yield from scorched portions of crowns of trees that had survived a fairly hot July fire. Seed yield from unscorched portions of the same crown was used as a check. The data indicate that a loss of from 20 to 60 percent in seed production is ascribable to crown scorching.

Preliminary data on relation of seed yield to cone size indicate that the average weight of seed more than doubles with a doubling of cone volume. Although seed counts remain to be made, it is believed that most of the weight difference is due to larger seed in the large cones. If this is true, and if larger seed produces stronger seedlings, control of cone size through selection of seed trees may offer an additional means of improving early growth of longleaf seedlings.

(b) Seedling nutrition. Uniform application of sawdust, composted for two years with and without soil and mineral fertilizer "activators," on two parallel nursery beds gave extremely variable results when seedlings were outplanted into the field in mid-March 1947. First-year mortality for seedlings which had been composted with sawdust alone averaged generally higher than for other composts or for all checks. The test was severe because of the late planting (March 14) and prolonged drought in July and August. The relatively satisfactory response to some of the "activated" sawdust suggests possibilities for using this material for improving organic content in nursery soils.

A small exploratory test of the effect of a mixture of fertilizer and growth regulator added to roots at planting time in a clay carrier gave some promise of promoting growth and vigor of longleaf pine seedlings. Roots were dipped into the clay mixture, which was thick enough to adhere abundantly to the roots. At the end of the first season, seedlings puddled in the "charged" clay survived slightly better than checks (70 percent versus 60 percent, respectively) and had somewhat more vigor. On the other hand, hardwood leafmold (finely pulverized and similarly charged with nutrients and growth regulator, and added directly into the planting slit) was harmful. So was leafmold alone.

Regeneration

Pine planting

A complete analysis was made in 1947 of the data on 122,000 seedlings planted by the Civilian Conservation Corps to test the first-year survival of longleaf and slash pine on cut-over longleaf land. The following results apply primarily to these two species on such land, and should be extended only with caution to other species and sites:

(a) Pine plantings on fresh burns, in 1-year rough, in unmodified old rough, in hoed spots, and in plowed furrows were tested for 4 successive years. Few significant differences in survival resulted, and these were reversed from site to site and from year to year. These findings do not apply to special cases, as "crawfish flats," lespedeza patches, or abandoned Bermuda-grass or carpet-grass pastures, but it seems definite that in Andropogon scoparius rough, furrowing, scalping, or burning in advance of planting are not worth the extra cost, and may even reduce survival.

(b) October or early November planting, and late March or any April planting, were hazardous. The results confirmed the practice of starting planting as early in December as rains softened the ground, and completing planting in February if possible, but continuing a few days into March if necessary. Rabbit damage to planted slash pine was greater in the first half than in the second half of the season.

(c) Root systems pruned to 2 or 3 inches consistently gave survival very significantly poorer than that of all classes longer than 4 inches. The results confirmed the common practice of pruning roots to 7 or 8 inches, but saving all seedlings with roots 5 inches long or longer.

(d) Although results in repeated tests were not entirely consistent, exposure to wind, and especially to sun and wind, for more than 3 to 10 minutes generally reduced survival a little. Some survival (64 to 40 percent) was obtained from seedlings exposed to sun and wind for 40 to 80 minutes in a single layer on a hard-packed path. Exposure for more than 80 minutes generally gave very low survival. Evidently chance exposure for a minute or two was not responsible for large variations in plantation survival, and piles of seedlings accidentally left exposed for half an hour need not be thrown away.

(e) A great variety of tests indicated that with reasonable care storage in bales or in heel-in beds was feasible for 14 and often for 28 days. Soil texture, soil drainage, and shading of the heel-in mattered little as long as the seedling roots were covered with earth. The one clear-cut flaw in old methods was storage in tubs of water; 1 to 3 days in tubs reduced survival appreciably and 7 to 28 days of such storage was fatal. It is concluded that existing storage practices--except storage in tubs of water--do not appreciably affect survival.

(f) Provided the seedlings were set at correct depth, tools or methods of using them resulted in few significant differences in survival, and these few were not consistent from species to species or year to year. Tools evidently may be chosen on the basis of labor economy (in which they vary greatly), since they affect survival so little. The results give reasonable assurance that a correctly designed and operated mechanical planter will permit satisfactory survival.

(g) Setting seedlings too deep had practically no significant effect on first-year survival--it is recognized that it may reduce subsequent survival of longleaf--but setting them even 1/2-inch too high tended to reduce survival significantly, and greater elevation resulted in very significant mortality. Since correct depth of setting is particularly difficult with mechanical planters, this point is important.

(h) Leaving the planting slit entirely unclosed reduced survival very significantly, as did stripping off most of the side roots, or subjecting each seedling to two or three malpractices at once. Other "faults" in planting had negligible effects. Providing the top was closed, tight closure of the bottom of the planting slit was less important than has been assumed. Other treatments proved that a second closing slit to fill in the first closing slit is wholly unnecessary.

(i) Tests of several treatments involving "puddling" and root stimulation in 2 different years yielded practically no significant differences in survival except terrific mortality from overdoses of fertilizer in the "puddling" mud. No significantly beneficial treatments with Auxilin or Hormodin A (indolebutyric acid) were disclosed. It was shown conclusively that "puddling" was not of itself harmful, as had been asserted by many, and that it might be slightly beneficial in some instances, though hardly enough to justify any extra cost or effort.

At the end of the third year of initial-survival experiments, then, it was evident that the things done to the stock on the planting site did not account for the really great differences encountered from place to place and year to year in good routine planting. Only extreme treatments--planting in April, pruning roots shorter than 4 inches, exposing roots more than 20 minutes, setting stock too high, or failing to close the top of the planting slit--produced differences as great as those sometimes occurring in a quarter-mile of routine planting strip, or between check and check in various experiments. It was concluded that the reason for good or poor survival must lie mainly in the planting stock itself. This conclusion directed attention to effects of nursery practice on survival. Additional results from the analysis of this phase of the investigation are as follows:

(j) Sorting the then accepted "morphological" grades (based on size and on foliage development) of longleaf seedlings into numerous "sub-grades" based on size confirmed earlier observations that the seedlings of intermediate size survived very significantly better than the larger ones. A similar study of slash pine grades and sub-grades completely upset previously existing notions of seedling grades. Six "plantable" and six "cull" sub-grades, distinguished by size, foliage development, and degree of dormancy, were defined. Duplicate series of seedlings of these twelve sub-grades were selected from two beds of like age in the same nursery. One bed was designated as "superior" because it had a preponderance of "plantable" sub-grades, and a general appearance of thrift and vigor. The other bed was designated as "inferior" because it had a preponderance of "culls" and appeared unhealthy. Yet, sub-grade for sub-grade, the stock from the "inferior" bed survived and grew very much better than that from the "superior" bed (average survival, all sub-grades combined, 88.2 percent for "inferior"; only 70.6 for "superior"). "Culls" from the "inferior" bed survived and grew better than some of the plantable stock from the "superior" bed. Here was clear evidence of an internal condition--a "physiological grade"--of planting stock influencing survival more than most of the planting techniques tested in earlier experiments.

(k) Following the lead obtained by testing matched sub-grades of stock obtained from different beds, the effect on "physiological grade" (and hence on survival) of modifying the reserves of stored food within the seedlings was studied. This was done by shading seedlings for periods of from 3 to 12 weeks before planting and also by cutting off half the needles, or all the needles, on the day of planting or at various times up to 12 weeks before planting. Shading the seedlings on alternate days, or cutting off half the needles, actually tended to increase survival a little. Complete defoliation, or complete shading every day for 5 to 12 weeks, reduced survival very significantly--in one instance from 98.2 percent to 0.2 percent.

These shading and needle-pruning experiments are not offered as useful additions to nursery practice, for they are "negative" treatments, distinctly harmful in their effects. But they are evidence of the existence of "physiological grades" involving food reserves, grades in some instances impossible to detect by eye yet capable of affecting survival by 90 percent or more. It seems highly likely that such internal differences, arising in food storage, in mineral nutrition, or in other physiological processes, and not apparent to the eye, may account for many of the variations in survival in well supervised routine planting.

A few simple tests proved that one-half to three-quarters of the lateral roots could be removed from a seedling without altering its appearance enough to attract attention on the grading table, and that such injuries frequently occurred in both mechanical and hand-lifting. The effects of such root-removals were tested experimentally in one series of treatments by removing no laterals and all laterals from root systems of various lengths, and in another series by removing 0, 50, and 100 percent of all laterals. Removing even one-half the laterals reduced survival from 65.5 to 45.0, a very significant percentage. Removing all laterals resulted in plantation failure. The seedlings minus half their laterals ordinarily would not be detected during grading and packing, yet the presence of a batch of them could cause a poor spot in the plantation--a far poorer spot than most of the "faults" in planting so strongly emphasized in planting instructions.

Examinations were made of plots installed by the Mississippi National Forests on the Chickasawhay and Leaf Ranger Districts to compare longleaf pine survival and growth in machine planting and standard bar planting. In a hog-free pasture on the Chickasawhay District, July examination of a spring planting showed that about 50 percent of both hand-planted and machine-planted seedlings were in good to excellent vigor. Since there were approximately one-third more seedlings per unit area of machine planting than of bar planting, and assuming per-acre costs for both methods to be about the same, there appeared to be a clear advantage for the machine method on the basis of cost per seedling established.

On the Leaf River District, an August examination of a 5-acre test of machine versus bar planting of longleaf pine indicated that there was greater hog damage on machine-planted rows. Forty percent of the machine-planted seedlings were killed as against 7 percent of the hand-planted. (After the area was fenced in August, about 45 hogs were trapped out of 3,000 acres.)

Survival of both machine- and bar-planted seedlings was unsatisfactory, either because of late planting or the 6-week drought in July and August--the area is a sandy, dry, south slope. About 10 percent of all planted longleaf were rated as having a good chance of survival for both methods of planting. If hog-damaged and missing seedlings are disregarded, however, 19 percent of the machine-planted and 12 percent of the bar-planted had a good chance to survive.

Both the Leaf and Chickasawhay tests indicate that machine planting is not inferior to bar planting, but the site must obviously be hog-free to avoid the heavy losses experienced on the Leaf District.

A stock lot of slash pine seed from the 1931 crop, stored for 15 years at 35° to 38° F. and at 9 to 10 percent moisture content in sealed glass, was tested by cooperators and germinated 88.7 percent. So far as is known, this is the longest period seed of any southern pine has been stored successfully.

The revision and rewriting of Technical Bulletin 492, "Artificial Reforestation in the Southern Pine Region" was continued. The job is better than two-thirds completed.

Cottonwood planting

Recent work in cottonwood planting has been directed mainly toward the control of competing vegetation during the first growing season and the assurance of a satisfactory stocking, free of competition, at the end of the second year. For comparative purposes, satisfactory stocking is considered to be 400 trees per acre. This seems to be the minimum number which can be relied upon to produce trees of satisfactory quality by the time a thinning becomes practical. With the recommended 6- by 10-foot spacing, or 726 trees per acre, not less than about 407 trees, or 56 percent, must survive and reach a height of at least 36 inches by the end of the first growing season for stocking to be considered satisfactory. Trees at least 36 inches high are tall enough to stay above most flood water and vigorous enough so that second-year mortality and that of succeeding years is normally very low.

The year 1947 was extremely dry and provided the opportunity to test results of fertilization and release against those of 1946, a relatively wet year. In 1947, only two out of 38 cultivation and fertilization treatments resulted in survival of 56 percent or better of trees at least 36 inches in height. The converse had been true in the wet year of 1946, when only two of the 38 treatments failed to produce this survival. In 1946, almost any combination of fertilization and release gave good results. Dry seasons are more exacting in their demands; hence a treatment cannot be recommended unless it works well in a dry season. The use of 6 ounces of nitrate of soda, applied on the ground at planting, and one release when competing vegetation was one-half to three-quarters the height of the trees, gave satisfactory survival in both 1946 and 1947. The application of fertilizer successfully replaced one release cultivation. Fertilization without release was not satisfactory in 1947. It stimulated weed growth more than tree growth and caused the trees to become overtopped and shaded out.

Tests using refrigerated cottonwood cuttings to provide stock for late planting on sites subject to flooding were repeated in 1947. They showed that planting should be done at the earliest date at which there is a reasonable chance of escaping floods. Planting after May 15 is of doubtful value on any site in a dry year, though planting as late as June 15 on swamp sites may prove successful in a year of normal rainfall.

Small-scale tests of the nursery production of cottonwood cuttings were enlarged in 1947. Yields were not so good as the first tests had indicated, though 12-inch spacing in rows 40 inches apart produced an average of about 12 thousand 20-inch cuttings per acre the first year. Previous soil treatment of the area had a deleterious effect on this figure, and indications are that the number can be substantially increased under normal conditions. With an expected 4-year production of 300 thousand 20-inch cuttings per acre, it appears that the cost will be approximately 25 cents per thousand cuttings. To this must be added the cost of harvesting and making cuttings, which was $3.80 per thousand, using only hand labor. In large-scale production, the development and use of mechanical equipment would materially reduce the cost of making cuttings.

Work directed toward preplanting control of competing weeds and vines was continued in cooperation with the Mississippi National Forests. Reexamination of 1946 treatments showed that all were unsuccessful. The Ranger's Pal plow was too light to make a satisfactory furrow in heavy buckvine cover. A heavier hydraulic plow made a good furrow about 3 feet wide, but by fall buckvine shoots had come in from the side and covered most of the planted cottonwood even though the bottom of the furrow was still essentially bare. The bulldozer also was unsatisfactory.

In November 1946, wider and deeper furrows were made through a heavy growth of buckvine by using a four-disc Mathis fire-line plow. A furrow 5 feet wide and 6 inches deep with an additional roll of soil and debris from 12 to 18 inches wide on either side gave an open strip 7 to 8 feet wide. The strips were spaced 10 feet apart, center to center. On a 10-acre area, on which the Mathis plow was used, six combinations of fertilization and hoe release were tested with plantings made in March 1947. The lowest costs were obtained in this study, though they are probably the maximum to be expected on the most difficult sites. The indicated total establishment costs per acre through the first growing season at a 6- by 10-foot spacing (726 trees per acre) are as follows, with common labor at 50 cents per hour.

Removing logs and down trees before plowing	$3.85
Site preparation with Mathis plow	8.15
Cost of growing planting stock	.20
Harvesting and preparing cuttings	2.75
Planting	2.75
Fertilization (ammonium nitrate and labor)	6.50
One hoe release (5-foot strip)	16.50
Total cost per acre	$40.70

Obviously these costs will be less where there is no down timber to remove or on abandoned agricultural land where full site preparation is not necessary. At the same time, these results indicate that costs must be lowered considerably for cottonwood planting to be commercially practicable. The hoe release and probably the fertilization also can be eliminated if a weed killer can be found to control the competing vegetation. Such a development might well cut the cost of establishment on a difficult site from $40 to about $20 per acre.

On the above area, under the three best treatments a satisfactory number--from 57 percent to 67 percent--of the original planting reached a height of at least 36 inches at the end of the first season. The average heights of these trees ranged from 45 to 50 inches. Two ounces of ammonium nitrate were applied to each tree in holes at the time of planting, on the ground at planting, and in holes 7 inches deep in late May. One hoe release in June removed all competing vegetation growing within the 5-foot wide furrow.

In considering these findings, it seems likely that further study has every opportunity to reduce the cost of establishment of cottonwood plantations. As the cost approaches $15 per acre, presently judged the economic maximum, the opportunity unfolds for planting large acreages of cut and burned-over Delta lands not suitable for agriculture. Experimental nursery work has indicated very low cost for the production of cuttings. The use of refrigerated cuttings gives promise of satisfactory survival even if planting is done after the flood period. The four-disc Mathis plow provides adequate site preparation in unfavorable situations. Study of weed killers may lead to methods obviating the need for fertilization and cultivation. All in all, though more research is needed, the future possibilities of cottonwood planting look bright.

Pine plantation management

The Tallahatchie Branch made a study of a set of 19-year-old plantations near Jackson, Tennessee. Longleaf, slash, and loblolly pine were quite successful. Shortleaf pine was still heavily infested with tip moth. The longleaf was planted on what was apparently the worst-eroded site, but the erosion has been completely controlled. Evidently longleaf and slash pine can be successfully planted in central Tennessee. The volumes per acre produced by the several species at 19 years with 6- by 6-foot spacing are given in Table 9.

Table 9.--Yield per acre of 19-year-old pines planted 6 feet by 6 feet at Jackson, Tennessee

Species	Yield
	Cords
Loblolly	14.0
Longleaf	12.2
Shortleaf	10.5
Slash	10.2

In central Louisiana, observations were made in an unthinned 20-year-old loblolly pine spacing study plantation. The plantation had been established on a 40-acre tract of cut-over land. Table 10 summarizes the results.

Table 10.--Influence of spacing on success of a 20-year-old plantation in central Louisiana

Approximate spacing (feet)	Survival	Trees 4 inches and larger in diameter		
		Number	Basal area	Volume
	Percent		Sq. ft.	Rough cords
4 x 4	37	887	147	24
6 x 6	51	588	130	23
6 x 8	67	490	140	27
8 x 8	68	294	112	24

The volume growth has been more than 1 cord per acre per year for all spacings. Greater growth might have been obtained in the closer spacings if timely thinnings had been made. The wider spacings probably are best if such thinnings are not planned.

Near Bogalusa, Louisiana, a 20-year-old slash pine spacing study plantation was remeasured. This stand was thinned at 15 years of age. The total yields obtained for each spacing are shown in Table 11.

Table 11.--Effect of spacing on slash pine volumes per acre at 20 years

Spacing (feet)	Volume standing plus previous thinning
	Cords
5 x 5	30
6 x 6	27
8 x 8	26

In terms of pulpwood stumpage values of the total yields to date, the 8 x 8 spacing would yield the best returns, $49 at 20 years of age. This is mainly because harvesting costs are lower for the larger diameters produced by this spacing. Returns from the 5 x 5 and 6 x 6 spacings would be $43 and $39, respectively. The greatest ultimate profits undoubtedly will be from a main crop of high-grade sawlogs and poles. For this objective, the closer spacings probably will be best because they should produce trees of highest quality.

Spacing plantations have also been studied from the point of view of Cronartium (southern fusiform rust) infection. An examination of a 13-year-old slash pine plantation near Alexandria, Louisiana, indicates that close spacing checks the rate of rust infection. This is shown by the data in the following table:

Table 12.--Effect of spacing on the incidence of Cronartium in Louisiana

Location of Cronartium cankers	Density (number of trees per acre)			
	1516	1004	796	189
	Percentage of trees with cankers			
Stem	10.6	13.0	14.1	19.1
Branches	4.7	5.1	6.8	9.6
Total	15.3	18.1	20.9	28.7

A slash pine plantation in south Mississippi, 11 years old, was also examined for rust infection. As Table 13 indicates, results corroborate the above findings.

Table 13.--Effect of spacing on the incidence of Cronartium in Mississippi

Origin of stem infection	Density (number trees per acre)	
	1012	447
	Percentage of trees infected	
From branch infections	7.7	27.4
Direct infection	14.7	15.1
Total stem infection	22.4	42.5

The difference on Cronartium infection is attributed mainly to density of stand. In the closer spacing, branches are dead to a much greater height. Death of a limb spells doom for any canker it supports, thereby preventing cankers from extending into the stem.

The choice of species to be planted is especially important in central Louisiana, where ice storms and Cronartium infection appear to militate against slash pine in favor of loblolly. Woods burning, on the other hand, is less damaging to slash pine than to loblolly.

Table 14 illustrates these points with data from a study in a 10-year-old mixed slash-loblolly pine plantation in that area. After 10 years (a) loblolly survived better than slash pine; (b) slash pine survived burning better than loblolly; (c) in height growth, loblolly exceeded slash pine on the unburned, but slash exceeded loblolly on the burned, indicating again the superior resistance of young slash pine to wildfire; (d) in diameter growth, loblolly was larger than slash on the unburned but slightly smaller on the burned area; (e) slash pine was more heavily infected with fusiform rust; and (f) slash pine was more seriously damaged by ice storms.

Table 14.--Comparative data on slash and loblolly pine planted in central Louisiana

Item	Slash			Loblolly		
	Burned	Unburned	Av.	Burned	Unburned	Av.
			Percent			
Survival	52	72	62	59	93	76
			Feet			
Height	20	21	20.5	19	24	21.5
			Inches			
Diameter breast high	3.2	3.3	3.25	3.1	4.1	3.6
			Percent			
Cronartium:						
Trunk only	22.0	13.7	17.8	5.9	5.3	5.6
Trunk and/or limbs	27.5	21.9	24.7	20.6	9.6	15.1
Ice damage: 1/						
Moderate			11.4			1.7
Serious			9.6			2.5
Branch breakage			13.3			1.0
Total			34.3			5.2

1/ Moderate and serious ice damage are defined respectively as trees leaning from 10° to 45° from the vertical, and trees leaning more than 45°. Branch breakage is exclusive of trees with trunk injury.

To appraise further the nature and extent of damage in central Louisiana from the ice storms of 1944 and 1947, a survey was made of pine plantations in March 1947. The more pertinent findings are: (a) pine plantations only a few years old suffer less damage from ice than older plantings; (b) branch breakage is the most common form of injury and may cause only a slight reduction in growth; (c) trees with tops broken often develop lyre-shaped tops, and larger trees severely bent develop a permanent sweep; (d) slash pine is the most susceptible to damage, longleaf is apparently only slightly more susceptible than loblolly, and shortleaf is very resistant; and (e) natural stands are just as susceptible as planted stands when size, density, or other factors are taken into account; the percentage of damaged trees is likely to be greater in dense than in open stands.

The preceding results relating to a choice of species for planting purposes indicate that slash pine has serious limitations for extensive planting where ice storms occur, and that loblolly may be a relatively better tree than formerly thought for many sites in this area.

Further information on ice damage was obtained in an informal study in north Mississippi. The following observations are based upon the examination of approximately 100 plantations, one-half of which exhibited some ice damage: Shortleaf pine under 10 years old is relatively immune to ice damage. Damage to older shortleaf trees was usually trunk breakage, as very little bending occurred and damage of all kinds was less in shortleaf than in loblolly and slash plantations. Loblolly is relatively immune to damage in plantations less than 7 years old; in some loblolly plantations in the 9- to 13-year-old class, an average of 45 percent of the trees was damaged. Slash pine damage in the 3- to 5-year-old class exceeded damage to similar-aged loblolly but was about the same for both species in 9-year-old stands. Longleaf pine in one 7-year-old plantation adjacent to severely damaged loblolly and slash plantations of the same age, was undamaged (height of the longleaf was considerably less than the other species).

In general and regardless of species, ice storm damage in north Mississippi was heaviest near the edge of the stand or near openings; stem breakage occurred most frequently in older stands, roughly at the ratio of one broken to eight or ten bent trees. By June most standing trees with few or no lateral branches left after the storm had been fatally attacked by insects, principally Ips. By November, in two of six severely damaged plantations (loblolly) undamaged trees surrounding the damaged trees had been killed by Ips in a number about equal to those which had been ice-damaged and killed.

Further study is needed of the extent, periodicity, and severity of ice storms to determine whether such a hazard is sufficient to prohibit the use of the most susceptible species in certain areas or at certain times. The greatly expanded program of planting idle and abandoned areas principally with pine increases the significance of this problem.

The reexamination of a study established by P. V. Siggers in 1935 on the Palustris Experimental Forest showed that early and frequent spraying with Bordeaux mixture in various adhesives for brown spot control markedly stimulated early height growth of planted longleaf pine. Spray treatments were applied five times over a 2-year period starting at the end of the first year in the field. The results after 12 years are given in Table 15.

Table 15.--Effect of Bordeaux mixture spray on planted longleaf pine

Treatment	Survival	Average height
	Percent	Feet
A. Casein spreader and homemade Bordeaux	39	22.7
B. Raw linseed oil and homemade Bordeaux	43	24.0
C. Whale-oil soap and homemade Bordeaux	32	20.4
D. Whale-oil soap and powdered Bordeaux	30	22.3
E. Raw linseed oil, emulsified in water	33	12.3
F. Unsprayed checks	35	7.4

Erosion control plantings

Closely allied to much of the foregoing work, but directed particularly toward the control of erosion, was an analysis made of plantings in north Mississippi and western Tennessee. Most of the plantings had been established several years ago by the CCC in cooperation with both the Forest Service and Soil Conservation Service. Plantings were selected on the basis of similarity of species, number of growing seasons, seed source, nursery, planting stock grade and class, planting season, site improvement, planting method, and site. Observations were made on the plantations to determine their erosion control effectiveness, their success or failure as a planting, and the factors contributing to and associated with their success or failure.

A preliminary check of field observations reveals that loblolly pine was outstanding both as to growth and erosion control. The effectiveness of shortleaf pine was severely hindered by tip moth. Virginia pine in Tennessee was excellent for soil stabilization purposes. Black locust was apparently very effective the first 2 or 3 years after planting, and, when located on good sites, continued its effectiveness. On sites of poor quality, black locust plantings appeared to be more susceptible to attack by borers and have died out about five years after planting; black locust plantations on bare, actively eroding areas were generally failures. Areas of deposition, of sufficient depth, provided excellent planting sites, regardless of source of material.

Soil and litter characteristics of two plantations near Jackson, Tennessee, were studied. They disclosed strikingly the fact that loblolly pine, with its heavier needle fall, provided much heavier depths and amounts of litter, important to the control of erosion, than did shortleaf pine. Compactness of surface soil was approximately twice as great under the two pine stands as under a nearby upland hardwood stand and approached that of a grazed open pasture. Water absorption was proportional to compactness.

Fire

Prescribed burning

A field survey, in cooperation with the Mississippi National Forests, of 17,000 acres of prescribed burning in the longleaf-slash pine type in south Mississippi indicated a net benefit of about 9 cents per acre. The cost of planning, plowing, and burning was 20 cents per acre. To that must be added losses from mortality and reduced growth of about 38 cents, a total cost of 58 cents per acre. Benefits from brown spot control, reduction of probable wildfire damage and fire fighting cost, and seedbed preparation were estimated to total 67 cents per acre. Considerable damage to 1-inch d.b.h. longleaf pine showed up, indicating the desirability of raising the minimum size stand to burn for fuel reduction from 6 feet in height to 2 inches in diameter at breast height.

A quick survey of the Conecuh Ranger District in Alabama indicated that prescribed burning was desirable for seedbed preparation. Preliminary reports following the 25,000-acre late summer prescribed burn indicate that the objective was attained and an excellent catch of pine reproduction has been obtained.

In April 1947, needle growth of slash and longleaf on burned areas in south Mississippi was compared with growth on nearby unburned areas. Trees defoliated by winter fires had made more early needle growth than unburned trees. Fires the previous winter had no apparent effect on needle growth, although new shoot growth was smaller on the burned trees than on nearby trees unburned for at least 2 years. Stimulated needle growth was confined to the part of the crown where needles were killed by heat. Where needles were burned off slash pine, the branches were usually killed. Longleaf pine branches were not so often killed when needles were burned off.

A small study of seasonal burning indicates that when longleaf seedlings are about four years old growth on plots lightly burned in the summer is better than on light winter burns. Growth on the light winter burns was better than on the unburned plots. The poorest growth was found on the plots burned severely in the winter. Survival (approximately 65 percent) was about equal for each of the four treatments. Subsequent summer fires killed more trees than winter fires.

Norris-Doxey Farm Forestry Projects

This Station maintains a Norris-Doxey cooperative farm forestry research project with the Alabama and Mississippi Agricultural Experiment Stations.

Mississippi

The project in Mississippi is directed at solution of farm forestry problems of the north central and northeastern portions of the State. In 1947, field work was completed and intensive analysis almost completed in a survey of forest plantations in this region. Final results of the study, which will be used to guide future forest planting, are not yet available.

Alabama

This project is aimed at solving farm forestry problems in central Alabama. In 1947, work was concentrated on remeasuring, analyzing, and writing up forestry studies installed by the Alabama Agricultural Experiment Station. This was done in close cooperation with the Alabama Station, with the objective of preparing several publications summarizing results of the important research to date and showing specifically how the results are useful in improving forestry practices. The principal studies worked with in 1947 were: (1) growth of mixed loblolly-slash and loblolly-shortleaf plantations, (2) growth of southern pines planted in different sites, and (3) results of underplanting pines in hardwood stands.

A tentative working plan for a new project to determine the costs and returns of good farm forest management in central Alabama was prepared late in the year.

Pine Sawfly

For 7 years the pine sawfly (Neodiprion sp.) has been defoliating a large acreage of shortleaf and loblolly pine timber in southern Arkansas. In 1946, the area of timberland affected was estimated at 1 million acres, although not all the trees on this area were attacked nor were all trees completely defoliated. Loss of timber as a result of the defoliation had been small. Potential secondary losses of large proportions, however, might have been brought about by a severe drought or an outbreak of bark beetles.

In order to determine the seriousness of the situation, an analysis was made by the Crossett Branch. The report of this study resulted in a cooperative control project in which the Bureau of Entomology and Plant Quarantine, the larger timberland owners of south Arkansas, and the Southern Forest Experiment Station took part in the spring of 1947.

Four concentrations of DDT fuel oil mixture were applied by aerial spraying on a series of plots measuring 660 by 5280 feet.

Results indicated that the lightest concentration of DDT used, ½ pound in 1 gallon of fuel oil per acre, was effective in killing the young sawfly larvae. Should it be necessary, an outbreak could be brought under control by aeroplane spraying for about $1.00 per acre. Fortunately, widespread control by use of DDT does not now appear to be necessary. The parasites and predators seem to be bringing this insect under control some seven years after the outbreak began (see page 62).

FOREST ECONOMICS

Forest Resource Analysis

Forest landownership and management in central Mississippi

Taking a cue from the Forest Service Reappraisal, which pointed up important differences in forest management practices among the various classes of forest owners, this Station, in cooperation with the Mississippi Agricultural Experiment Station, began a study of forest landownership and management in central Mississippi. The study is confined to private holdings in 28 counties. Its purpose is: (1) to discover the most useful classification of forest landowners and learn how much land is held in each class, (2) to relate management practices to class of owner, (3) to inquire how the important factors influencing management vary by class of owner, and (4) to determine some of the specific methods by which improvements in forest management are most likely to be achieved.

Field work was completed, with ownership records taken at each county seat and 600 individual owners interviewed.

Although the information collected has not yet been formally analyzed, several facts already stand out quite clearly:

There is a wide variation in management practices in every class of ownership, but the larger, more informed, and better financed owners tend to follow the better practices. Although the rate of progress is uncertain, there is a definite trend toward improved attitude on the part of forest owners of all classes toward their timberland. Many owners have been won over to a belief in the high potentialities of their forests. Even more owners stand on the threshold of this persuasion.

Improved practice is most noticeable in the case of fire protection. Attitudes and results vary widely among counties, but long preaching against fire has had effect, particularly in areas near the practical demonstrations of national forests and well-protected lumber- and pulp-company land. While many owners do not actively combat or attempt to discourage woods burning, the weight of public opinion is against fires, and only rarely will an owner admit taking any part in woods burning.

The greatest single obstacle to good management by forest owners is lack of comprehension of what improved management consists of and what its potential results are. Other important obstacles are financial need, the claims of other occupations and activities, physical inability or lack of inclination to supervise cutting operations, and the distance between residence and forest.

Despite the obvious responsibility of owners to manage their own land, a large share of responsibility rests with the forest-products industries which use the timber. Many owners are sufficiently informed to be interested in cutting more conservatively, but they feel compelled to rely on cutting by logging contractors who do not have an interest in maintaining the productiveness of a forest area.

Land use in southwest Louisiana

Growing planted pines and grazing cattle offers a real opportunity for better production and income from southwest Louisiana's cut-over lands. To meet the needs of the thousands of owners, both large and small, for information on planting and grazing of their cut-over forest land, a special study was made in 1946 of successful pine plantations and forest grazing. The report on this study, outlining improved practices and their costs and returns, was pushed toward completion during the past year.

Until the first commercial thinning of the planted trees at about 15 years of age, livestock is the chief product of the planted lands. For the first 5 years, annual gross returns from grazing are $0.77 per acre. These are gradually reduced as the trees crowd out available forage. The first thinning removes about eight cords of pulpwood per acre, worth about $12 as stumpage, or about $80 if the pulpwood is delivered to the plant. Periodic thinnings at 5-year intervals increase progressively in value as sawlogs and poles become available from larger and better-quality trees. The final harvest, except for seed trees, is made at the age of 60 years.

The average annual gross income from stumpage during the whole rotation would vary with the products cut, ranging from an average of $2.70 per acre, when all trees are cut into pulpwood, up to $13.00 when integrated utilization for poles, sawlogs, and pulpwood is practiced. When pulpwood only is cut and delivered, it has a value of nearly half that of delivered products from integrated utilization, but pulpwood production requires considerably more man-hours of labor than does production of the other products.

Forest Resource Inventory

Timber resources of Mississippi and northwest Arkansas

The field inventory phase of the Forest Survey was completed in 39 central and Delta counties in Mississippi (all of Survey Units 1 and 3) and 16 counties in northwest Arkansas (about seven-tenths of Unit 5). Data were taken in these counties on forest area and condition, timber volume, growth, and mortality. At the close of the year, four 2-man cruising teams were working in northwest Arkansas toward completion of this never-surveyed portion of the State.

Cubic-foot volume tables

The preliminary tables drawn up in 1946 were tested and revised, and published in 1947. These tables, based on tree diameter and form class and applicable to all southern timber and eastern hardwoods, show cubic-foot volumes, inside bark, in (1) the sawlog portions of sawlog-size trees, (2) the merchantable tops of sawlog-size pines, and (3) the merchantable stems of trees under sawlog size. Factors have been appended to the tables for converting inside-bark volume to volume outside bark.

Forest-economic statistics

From the Forest Survey, the Forest Service Reappraisal, and other sources, a start was made in compiling and organizing highlight data on area, volume, growth, drain, industry, income, and employment for the southern States. In cooperation with the Southeastern Station, these data are being arranged in a form suitable for use in a general publication of forest-economic information for the South. They will serve also as background for the Division's regional problem analysis, now in progress.

Economics of Forest Management

Evaluating management alternatives

To make the most of their forest properties, owners and managers have the continuing problem of choosing the best of the many management alternatives. They must weigh the relative economic returns from all-aged versus even-aged management, long versus short rotations, single- versus multi-product utilization, and numerous other alternatives. A study designed to develop methods of evaluating management alternatives has been initiated. During 1947 the study was restricted to the preliminary aspects of determining a method of arriving at the optimum volume of growing stock in all-aged forests for greatest net returns.

Intensive timber management

A study at the Crossett Branch in southern Arkansas has compared the pine yield from intensively managed shortleaf-loblolly pine stands with the pine yield from similar unmanaged stands. This study has been in progress for 9 years. At the outset, the unmanaged stands had a bigger timber volume, but the managed stands have grown at a much faster rate. Saw-timber growth has averaged 10 percent a year on the managed stands, only 5.2 percent on the unmanaged stands. In cubic volume too, the rate of growth on managed stands has been about twice that on unmanaged stands (Table 16). Management has included such measures as improvement and harvest cutting, thinning, the removal of most hardwoods over 4 inches d.b.h., and a small amount of girdling.

The progress of this experiment is another forceful illustration of the superior growth of managed over unmanaged stands in the shortleaf-loblolly pine stands of southern Arkansas and northern Louisiana.

Table 16.--Pine growth per acre in selectively managed and unmanaged stands of the Crossett Experimental Forest, 9-year period

Item	Saw-timber growth		Total growth	
	Managed stands	Unmanaged stands	Managed stands	Unmanaged stands
	Board feet[1]		Cubic feet[2]	
Original volume	4,180	5,640	1,197	1,484
Present volume	6,472	8,288	1,631	1,912
Growth plus cut during 9 years	3,762	2,648	751	428
Growth per year	418	294	83	48
	- - - - - Percent - - - - - - -			
Percent growth per year--simple interest	10.00	5.21	6.93	3.23

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[1] International 1/4-inch kerf scale. Applies to trees 11.5 inches d.b.h. and above.
[2] Volume inside bark. Applies to trees 3.5 inches d.b.h. and above.

Intensive management of farm woodlands

Projects have been established at six branch stations to serve as practical demonstrations of the financial returns possible from intelligent annual harvesting of saw timber and other forest products in small woodlands. Cultural treatments are contrasted on the same areas to some extent, but the main emphasis is on the application of cultural measures already proved desirable by research, in an effort to get maximum sustained financial returns. To simulate the small size of the average farm woodland, most of the experimental plots have been limited to 40 acres in size.

The longest study of returns from intensively managed farm woodlands in this Station's territory has been made at the Crossett Branch in southern Arkansas, where two farm forestry areas were established 11 years ago. One of the areas was a well-stocked tract of pine-hardwood timber when the study was begun; the other area was the same type but in the run-down condition typical of the farm forests of the region.

On the "good" 40-acre tract, ten annual cuts have been made. Timber volume is approximately the same as it was at the beginning of the study, but quality has been improved considerably through the policy of selecting the poorer trees for cutting and reserving the better trees for growth. The high yields over the 10-year period are summarized in Tables 17 and 18.

These figures indicate that when farm woodlands of the pine-hardwood type on average sites west of the Mississippi River are built up to good stocking, the returns can contribute a substantial portion of the farm income. One 40-acre tract of woodland can offer approximately three man-months of employment per year, most of it, if not all, during the winter "off" season when row crops are not being worked. Further, the figures show that the net returns per man-hour of labor in 1947 amounted to $1.27 including stumpage. The income per man-hour is from three to fifteen times that made from the usual row crops grown in the territory. This illustrates forcefully that timber can and should be as much an annual farm crop as corn or potatoes or cotton.

On the "poor" area (34 acres) at Crossett, nine annual cuts have been made, beginning in 1939. The policy has been to remove cull and poorest quality trees first, but all cuttings have been designed to pay their own way. The beginning ragged stand of pine and low-grade hardwoods has been improved in quality to a well-stocked stand of nearly pure shortleaf and loblolly pines. Volume of pine saw timber is now 3,022 board feet (Doyle) per acre, 1,127 board feet more than when the study began in 1937. Cubic-foot growth is already equal to that obtained on the "good" 40-acre tract. Despite the cautious cutting policy, yields over the 9-year period have been considerable. Stumpage returns have been

Table 17.--1947 cut on the Crossett "good" Farm Forty

Item	Logs	Pulpwood	Fuel wood	Posts	Total
	Bd.ft. (Doyle)	Std. cords	Std. cords	No.	
Volume cut	11,661	7.81	17.43	25	...
		Value (dollars) on stump			
Total value	206.73	15.62	13.07	1.25	236.67
Per unit	[1] 17.73	2.00	.75	.05	...
Per acre	5.17	.39	.33	.03	5.92
		Value (dollars) delivered at market			
Total value	364.15	83.96	209.16	3.75	661.02
Per unit	[2] 31.23	10.75	12.00	.15	...
Per acre	9.10	2.10	5.23	.09	16.52
	Man-hours of employment cutting and delivering				
Total hours	70.0	78.9	268.4	5.0	422.3
Per unit	6.0	10.1	15.4	.2	...
Per acre	1.8	2.0	6.7	.1	10.6

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[1] Stumpage by log grades, as follows: #1 logs, $25; #2 logs, $15; #3 logs, $10.

[2] Logs sold by grades delivered to mill, as follows: #1 logs, $38.50; #2 logs, $28.50; #3 logs, $23.50.

Returns per hour of labor in cutting and delivering

1.	Gross return with no deductions for stumpage	$1.57
2.	Net return with allowance for taxes, fire protection, 4 percent interest on $1,000 investment, and other out-of-pocket expenses	$1.27
3.	Gross return for labor and use of equipment after deduction of stumpage	$1.00

Table 18.--Total 10-year cut on Crossett "good" Farm Forty

Item	Logs	Pulpwood	Fuel wood	Posts	Total
	Bd.ft. (Doyle)	Std. cords	Std. cords	No.	
Volume cut	122,197	281.24	170.58	313	...
		Value (dollars) on stump			
Total value	1,298.83	330.12	96.86	15.65	1,741.46
Per unit	[1]10.63	1.17	.57	.05	...
Per acre	32.47	8.25	2.42	.39	43.53
Per acre-year	3.25	.82	.24	.04	4.35
		Value (dollars) delivered at market			
Total value	2,443.17	1,968.22	1,536.28	46.95	5,994.62
Per unit	[1]19.99	7.00	9.01	.15	...
Per acre	61.08	49.21	38.41	1.17	149.87
Per acre-year	6.11	4.92	3.84	.12	14.99

[1] Logs valued and sold on graded basis.

more than enough to pay interest and taxes, and cutting has provided about 58 days a year of profitable work for one man (Tables 19 and 20).

Table 19.--1947 cut on Crossett "poor" Farm Forest

Product	Volume	Stumpage value	Mill or market value
		Dollars	Dollars
Logs	4,521 bd. ft. (Doyle)	77.23	138.26
Pulpwood	5.16 cords	10.32	55.47
Total		87.55	193.73
Per acre		2.58	5.70

Table 20.--Total 9-year cut on Crossett "poor" Farm Forest

Item	Sawlogs	Pulpwood	Chemical wood	Fuelwood	Posts	Total
	Bd. ft. (Doyle)	Std. cords	Std. cords	Std. cords	No.	
Volume cut	24,503	135.43	105.02	53.40	121	....
Per acre	721	3.98	3.09	1.57	3.56	....
	- - - - - - - - Dollars - - - - - - - - - -					
Stumpage value	293.42	163.28	55.85	38.86	3.14	554.55
Per acre	8.63	4.80	1.64	1.14	.09	16.30
Mill value	515.16	1,045.34	547.38	541.38	8.47	2,657.73
Per acre	15.15	30.75	16.10	15.92	.25	78.17

At the Gulfcoast Branch Station, four farm-woodland tracts were managed last year for turpentine and timber products. A total of 465 trees (1,054 faces) were worked for naval stores, some of them under a selective-cupping program in which the trees are worked heavily for two seasons and then cut. The gum yield from these 35-to 40-year-old trees was 23.5 barrels and had a delivered value of $645.19. This represented a gross return per face of $0.61. The average hourly return of $0.89 for labor is well above prevailing wage rates in the area. Saw-timber and fence-post products removed from one tract under a very conservative cut had a stumpage value of $219.10. Delivered they were worth $553.00; this represents an hourly return for labor in felling, bucking, and yarding of $1.24. On this one 40-acre tract, the combined value of delivered products (sawlogs, posts, and crude gum) totaled $809.70. One year's record is not conclusive, but there is apparently an opportunity for considerable supplementing of farm income from forest-products sales in the naval stores region.

Other conclusions from the year's activities on the farm-woodland studies at the Gulfcoast Branch Station are: Second-growth trees as small as 8 inches d.b.h. can be worked profitably for gum under selective cupping if only one cup per tree is hung. Above 8 inches, 2 cups can be used profitably, and above 12 inches, 3 cups. Old-growth trees above 12 inches d.b.h. can have 3 cups also, but under 12 inches, only one cup can be hung profitably. Planting of longleaf and slash pines on some 15 acres with 6 x 6 spacing cost $9.75 per acre (labor costs computed at 60 cents per hour). Poisoning scrub hardwoods with Ammate cost $4.05 per acre (an average of 118 trees per acre, 2 inches d.b.h. and larger).

In East Texas, a one year's improvement cutting in a pine-hardwood stand resulted in an output of 883 hardwood ties on a 67-acre tract. At current prices, these ties had a stumpage value of $240.45, or $3.59 per acre, and a value delivered at the mill of

$618.10, or $9.24 per acre. This value represents 35 days of profitable employment to a farmer, his helper, and his equipment.

Farm forestry projects have been undertaken at other branch stations too, but formal results are not ready for release.

Forest Industry Analysis

Costs and woods waste in round mine-prop production

A study of mine-prop production in Alabama yielded insufficient data for direct cost comparisons in the use of the crosscut saw, bow saw, and power saw, but the indications are that power saws may prove the most efficient for the type of work observed. On the operation studied, a power saw was used to make 6.5-foot props, a bow saw to make 5.5-foot props, and a crosscut saw to make 6-foot props. The resulting average time required to produce a prop was 2.04 man-minutes for the power saw, 2.44 man-minutes for the bow saw, and 3.23 man-minutes for the crosscut saw.

Woods waste (material left in stumps and tops) varied in direct proportion to the length of prop cut (Table 21).

Table 21.--Percent of tree wasted in round mine-prop production

Length of prop (inches)	Loblolly and shortleaf pines	Virginia pine	Hardwoods
	- - - - -	Percent - - - - -	
32-34	1.4	12.5	2.0
66	3.0	...	3.4
96	14.5	25.0	18.2

Unit-package loading of pulpwood and chemical wood

Handling pulpwood and chemical wood in unit packages of one cord proved effective during wet weather at Crossett when it was impossible to drive trucks directly into the woods. A slide or "scoot" was loaded in the woods by hand and pulled by a D-4 or TD-9 tractor to graded roads. At the road, an A-frame loader built on an old truck and operated by a power take-off from the truck transmission picked up the unit by means of a sling and deposited it on a truck equipped with an extra set of standards.

Length of haul for the slide loads averaged 1/8 mile. Length of truck haul to the mill was 9 miles. A crew of three truck drivers, one tractor operator, six slide loadermen, one loader operator, and one supervisor, using three trucks, one tractor, and six slides, delivered an average of 26 cords of wood to the mill per 8-hour day. Costs per cord were as follows:

Slide and cable equipment	$0.06
Tractor use and depreciation	.48
A-frame loader--use and depreciation	.09
Trucks--use and depreciation	1.01
Labor--loading and hauling	2.42
	$4.06

This unit-package method of loading and hauling wood does not reduce production per man-hour of labor much, and it is considerably easier on the workers. However, it is a wet-weather method. During dry weather, when it is possible to drive trucks directly into the woods, the usual method of loading trucks by hand is cheaper.

Small lumber-mill realization values

Log grades developed at the Crossett Branch were found to be applicable to a study of lumber realization values at a small mill in east Texas. This study indicated that the grading of pine logs, combined with accurate scaling, permitted a reliable estimate of value. The analysis was prepared as an office report during the year. Some of the conclusions follow:

1. Value per M feet of rough green lumber (using OPA prices of 1946) increased in all log grades with increasing diameter as follows:

Grade 1 logs--from $44.45 at 11 inches to $56.54 at 19 inches.
Grade 2 logs--from $39.65 at 8 inches to $47.66 at 19 inches.
Grade 3 logs--from $36.74 at 6 inches to $40.23 at 18 inches.

2. Realization values on the milling process from log deck to green chain (i.e., the margin available to cover the cost of logs at the mill, profit, and risk per M feet mill tally) varied as follows:

Grade 1 logs--from $40.33 at 10 inches to $50.40 at 19 inches.
Grade 2 logs--from $32.26 at 8 inches to $41.91 at 19 inches.
Grade 3 logs--from $28.10 at 6 inches to $35.73 at 18 inches.

The knowledge of such variations in realization values will become increasingly important as the lumber market approaches normal conditions and efficiency in operations becomes a greater necessity for business survival.

Forest Industry Inventory

Annual census of lumber production

A survey of sawmills and lumber production was made for the year 1946 in cooperation with the Bureau of the Census and the Tennessee Valley Authority. All mills in the seven States of the Station's territory were covered.

For the first time on such a lumber census, mill operators were asked to report, not only how much lumber they produced, but also what counties the sawlogs came from. When compiled, these data will provide information on movement of lumber logs in the region.

The results of the census are being compiled by the Bureau of the Census.

A preliminary summary shows a total of approximately 12,800 sawmills in the seven States in Station territory in 1946, compared to 9,500 in 1942. The increase is explainable largely in terms of the more active lumber markets in the later year.

Annual pulpwood production

To keep abreast of developments in the pulp and paper industry, which is still expanding in the South, the Station canvassed pulp mills in its territory to obtain data on 1945 and 1946 pulpwood production. Mills outside the Station's territory but drawing pulpwood from it were covered as part of a similar canvass made by the Southeastern Forest Experiment Station.

Between 1936 and 1946, the number of pulp mills in the seven States of the Station's territory increased from 17 to 25, and pulping capacity increased 138 percent. Pulpwood production increased from approximately 1,700,000 cords in 1936 to 4,123,500 cords in 1946.

Pulpwood production and pulpwood receipts at mills are shown for 1946 in the following table. Because of a large inter-State movement of pulpwood, mill receipts and pulpwood production in any given State are not the same; nor do total receipts equal total production.

Table 22.--1946 pulpwood production and receipts at mills

State	Production			Receipts at mills
	Pine	Hardwood	Total	Total
	- - - -	Thousand standard cords	- - - -	
Alabama	731.2	25.2	756.4	655.9
Arkansas	511.5	65.6	577.1	367.0
Louisiana	766.1	20.9	787.0	1,786.0
Mississippi	983.9	254.3	1,238.2	577.7
Oklahoma	13.3	...	13.3	...
Tennessee	30.7	104.8	135.5	150.4
Texas	594.3	21.7	616.0	394.9
Total	3,631.0	492.5	4,123.5	3,931.9

As a step toward assuring an adequate wood supply, pulp companies had acquired and were holding a total of 3,446,300 acres of forest land in the seven States by 1946.

Timber drain in Mississippi

To complement the inventory of forest area and timber volume, growth, and mortality currently being made in Mississippi, data were collected for estimating 1946 cutting drain. Prerequisite to such an estimate are (a) a knowledge of the quantity of logs or wood in other forms used by forest-industry establishments and other timber operations in the area, (b) information as to the locality from which the timber came, and (c) factors or allowances for converting wood-use data into terms of the standing-timber equivalent as carried in the Forest Survey inventory. This standing-timber equivalent is referred to as timber drain.

The estimate of 1946 timber drain in Mississippi will be based in part on mill-production and timber-source data from the annual lumber census and pulpmill canvass described above. In addition, a canvass was made of nonlumber forest industries in the State for information on 1946 wood procurement and timber source, and of cross tie and pole production. Mississippi nonlumber forest-industry establishments in 1946 included 25 veneer, 39 cooperage, and 48 miscellaneous plants, the latter producing principally hardwood small dimension stock and handles. Approximately 2,500,000 hewed railroad cross ties and 950,000 poles and piles were produced in Mississippi in 1946.

To estimate fuel wood and fence post production and farm use of round or split material for barns, pens, paling, etc., use was made of the Master Sample of Agriculture, devised by the U. S. Bureau of Agricultural Economics and Bureau of the Census. The Master Sample of Agriculture is an area-sampling scheme in which, as it applies to Mississippi, the State has been divided into approximately 34,000 units. The basis for a State-wide estimate may be obtained by sampling a portion of these units. To provide the basis for estimating fuel wood and fence post production and miscellaneous domestic use, 35 Master Sample areas distributed systematically over the State were covered.

To derive factors for converting wood-use data to their standing-timber equivalent, sample-plot measurements were taken on cutting operations distributed over the State and among the different products.

At year's end, all field work on drain in Mississippi had been finished, and the data were being compiled.

Requirements, production, and supplies surveys

At the request of the Civilian Production Administration and, later, of the Office of the Housing Expediter, the Station continued through May 1947 a series of monthly estimates of lumber production and stocks begun for the War Production Board in 1942. The Tennessee Valley Authority handled the field work in most of Tennessee.

Lumber production during the first 5 months of 1947 was 11 percent above 1946 production for the same period.

Forest Products Marketing and Prices

An extensive survey of east Texas forest-products markets was made during 1946, the results of which were presented in 1947 as a Station release, "Marketing East Texas Timber Products." This report gave information on the various markets, covering (a) description of product, (b) specifications for raw materials, (c) unit of measure usually employed, (d) the usual method of purchase and radius of active purchasing, (e) minimum quantity accepted for delivery, and (f) current prices.

Grazing Management

Range forage

Two seasons of rapid growth, spring and fall, furnished the best grazing during a forage production study in the longleaf pine type in central Louisiana. About 60 percent of the 1947 forage was produced by May 15, during the first third of the growing season. Growth was slow in midsummer, but it picked up during late August to October, mostly from growing flower stalks.

Frequent and close grazing may greatly curtail grass and weed production on Louisiana bluestem ranges. Grass and weed production clipped from ungrazed plots is shown in Table 23. Despite a dry season, grass production was 2,000 pounds or more per acre on three areas harvested infrequently. Frequent harvesting caused a sharp drop in production to less than 1,500 pounds per acre. Frequent harvesting reduced the growth of weeds even more than of grass. The new growth from the frequently harvested plots had the greatest amount of proteins and phosphorus, indicating a need for a better understanding of the relation and quality of forage.

Table 23.--Grass and weed production on longleaf pine forest range, 1947

Harvesting frequency	Air-dry weight per acre		
	Grass	Weeds	Total
	- - -	Pounds	- - -
Frequent: every 2 weeks	1,293	122	1,415
Moderate: Every 4 weeks	1,466	126	1,592
Infrequent: every 8 weeks	2,100	189	2,289
Twice: May and September	2,000	275	2,275
Once	2,056	340	2,396

Forage production in second-growth longleaf stands in south Mississippi followed much the same trend as that in central Louisiana. Grass growth reached a maximum of 585 pounds per acre, air-dry, in the open timber stand, 374 pounds in the medium stand, and 214 pounds in the dense stand. Early in the season production was higher on unburned plots, but late in the season it was higher on burned plots. Production of weeds and legumes was consistently higher on the burned plots after April.

Burning the dead grass and tree litter made new forage growth more available for grazing than on the unburned areas. This difference was less pronounced in late summer and fall after needle cast.

Crude protein in grass samples was more than adequate for cattle in April, when it averaged about 12 percent. Crude protein content of 6 percent in late June was barely sufficient to maintain cattle weights. In August it was only 5 percent below maintenance. Calcium content was adequate in all seasons with a content of 0.22 percent or higher. In general, phosphorus content of the grasses was adequate in April, but thereafter showed the need for supplemental mineral feeding to cattle on range.

In south Alabama and west Florida, forest ranges were found to be transitional between the bluestem types of Louisiana and Mississippi and the wiregrass types of the southeast. More detailed work will be required to determine the amount and value of range forage in this transition zone.

Feeding range beef cattle in winter

The abundant forage on cut-over pine forest ranges during the growing season greatly exceeds the supply of suitable winter feed. Most range beef cattle owners provide little supplemental feed and their herds suffer severe losses during winter when the native forage is poor.

To find the best ways of wintering cattle on forest range, a supplemental feeding study was started 2 years ago in central Louisiana. Tests, which are continuing, are being conducted cooperatively with the Louisiana Agricultural Experiment Station.

One of the first things the studies showed is that range cattle suffer very heavy weight losses in fall and early winter, before supplemental feeding usually begins. In 1946-1947, for example, the test herd got its first supplementary feed on January 1, 1947. Before that time, however, cows that had weighed 700 pounds at the end of the summer had lost 80 pounds, and 400-pound yearlings had lost 50 pounds. This duplicated the experience of the previous winter.

These tests are demonstrating that cattle that get enough supplementary feed winter far better than those on inadequate rations. Between Christmas 1945 and mid-March 1946, both cows and yearlings lost 74 pounds apiece (in addition to fall and early winter losses) on a daily supplement of half a pound of cottonseed meal per head. For about the same period the next winter, the herd got 2.4 pounds of cottonseed meal per day and lost only 24 pounds per animal. The 50-pound advantage for the cows with more feed spells the difference between a productive and an unproductive herd.

Samples of the native forage eaten by cattle during the winter were found greatly deficient in protein and phosphorus, but the deficiency was overcome with adequate cottonseed meal. The full justification for supplemental winter feeding at present high costs will have to come in future benefits in the form of reduced death losses, more calves, and heavier market animals.

Sheep damage to longleaf pine

A study in south Mississippi showed that longleaf pine seedlings 2 to 48 inches high, and with white woolly buds at least 0.4 inch long, are very susceptible to browsing injury by sheep. Damage is seasonal (Table 24), being heaviest when the buds are most abundant and other palatable forage is scarce. Recent observations show that sheep also feed heavily on newly germinated longleaf seedlings, nipping the seed coats, wings, and cotyledons, and even uprooting and swallowing the entire plant. Damage is sufficiently serious yearlong, even under conservative stocking, so that until the seedlings are at least 4 feet high sheep should be excluded from areas where longleaf pine reproduction is desired.

Table 24.--Seasonal trend of sheep grazing damage to longleaf pine seedlings

Terminal bud injuries per acre per year	Jan. to March	April to June	July to Sept.	Oct. to Dec.	Total
Number	493	282	144	367	1286
Percent	38.3	21.9	11.2	28.6	100.0

Hogs on forest range

The woods hog has long been recognized as a major obstacle to successful regeneration of longleaf pine, but very little has been published on the nature and extent of hog damage. To measure hog damage and associated factors, a preliminary study was started in central Louisiana early in 1947. Practically all damage to pine occurred in March, April, and May--a season when other feed for hogs is scarce and the wet soil is easily rooted. The animals fed upon slash, loblolly, and longleaf root bark, but their damage to longleaf was most devastating.

Grass stage longleaf seedlings attacked by hogs were usually uprooted and killed. Saplings over 2.5 feet tall were damaged but seldom killed (Table 25). Hogs uprooted as many as 6,600 longleaf seedlings per acre during the 1947 season. Intensity of damage was highly localized. Some plots had no 1947 damage, while more than half the seedlings in adjacent plots were destroyed. Since they can do such serious damage in one year, hogs may cause complete failures in longleaf regeneration over a considerable area during a period of years.

Table 25.--Hog damage to longleaf pine, 1947

Height (feet)	Trees per acre	Killed		Heavily damaged	
	No.	No.	Pct.	No.	Pct.
0 - 1.5 (grass stage)	1152	872	76	24	2
1.6 - 2.5	480	0	0	80	17
2.6 and more	512	0	0	56	11
Total	2144	872	41	160	7

Chemical analyses contradicted the common belief that hogs feed upon pine root-bark only as a medicine or tonic. The root bark contained 85 percent carbohydrates, more than shelled corn does. It is estimated that a 150-pound hog can dig up its daily starch requirement in less than 2 hours when feeding upon pine roots.

Most upland farmers own not over 50 acres and run a few range hogs--generally enough to supply their own table. Few woods hogs are marketed, but home consumption is a real item. The animals usually roam over several square miles of "free range" with little or no herd management or supplemental feed. Death losses are very high. The problem of range hog raising and hog damage to pine needs a solution that will be fair to both forest owner and hog owner.

Forest grazing in the Ozarks

Burning, grazing, and destructive cutting have brought about such changes in the Arkansas Ozarks that neither timber nor forage is producing fully. Better information on true forage values is needed to help break the stalemate. A study was accordingly started of forage production and quality throughout the growing season, in burned and unburned hardwood stands. Total production (air-dry) in unburned stands was 143 pounds per acre in May while burned stands had only 94 pounds per acre. By July, however, production on burned areas surpassed that in unburned stands, and by August the burned areas reached 535 pounds per acre as against 394 pounds on the unburned. Weeds, mainly tall lespedezas and beggar-lice, also were more abundant on burned than on unburned areas by July. Browse was consistently more prevalent in unburned stands.

Strikingly enough, during the very hot and dry period from late July through August, forage production on farm pastures of the region practically stopped, whereas in woodland areas it continued to increase and furnished palatable forage for range cattle. However, the grass production in both burned and unburned poor hardwood stands is only one-third to one-sixth of the production in an open-meadow type. An average of only 140 pounds (air-dry) per acre of edible grasses and weeds in these timber stands indicates that at least 25 acres or more per cow are required for a 200-day season under conservative grazing.

Deer forage management in the Ozarks

Production and management of wildlife is an integral part of forest land use. Overbrowsing by deer on and near established game refuges in the Ozark National Forest in north Arkansas has threatened both game food and timber production. Therefore, a cooperative deer grazing study was started in 1944 by the Forest Service, the Arkansas Game and Fish Commission, and the University of Arkansas.

A rapid method of determining deer utilization of important browse and weeds was developed. Grazed range was compared with small ungrazed enclosures. Deer used grape and greenbrier as much as 95 percent in 1945. Trapping was expanded by the State to remove the excess deer. A downward trend in the utilization of key forage species in 1946 and 1947 indicated that browsing pressure has been reduced to within reach of the grazing capacity.

A special study was made of utilization of redcedar, since it is the principal winter deer feed as well as a valuable timber species. Trees from 1 to 4 feet high were tagged and measured in December, then remeasured in March. With the measured trees as a base, estimates of utilization were made rapidly on larger areas. Utilization of seedlings 2 feet and under was so heavy on the area studied that it will be very difficult to maintain redcedar as deer forage or to secure its successful reproduction for timber--a feature to be checked closely on all deer ranges in the Ozarks.

Chemical Control of Undesirable Hardwoods

Interest continues strong in controlling undesirable hardwoods and brush on forest and range land as owners realize the potential value of the growing space now occupied by nonproductive species. Hundreds of inquiries were answered by the Station in 1947.

There were several new developments in the oak control study in Louisiana in 1947. Ammonium sulfamate (Ammate) proved more practical and effective than sodium arsenite, 2,4-D, or other chemicals tested on upland hardwoods. Ammate crystals gave consistently better results than solutions. However, there are indications that strong solutions applied correctly are also effective.

The dosage of Ammate crystals and thus the cost of treatment recommended in Table 26 are somewhat less than the 1946 recommendations.

Table 26.--Ammate poisoning: doses and costs

Tree d.b.h. (inches)	Number of cups	Ammate per tree	Cost per tree
		Ounces	Cents
1 - 3	(Stump)	0.5	0.6
3 - 6	2	1.0	1.1
6 - 8	3	1.5	1.7
8 - 10	4	2.0	2.2
10 - 12	5	2.5	2.8

Stumps of trees smaller than 3 inches d.b.h. can be effectively killed by applying Ammate at once to a V-notch or a flat-topped stump. On trees over 3 inches d.b.h., cups (a double hack with the chip pried out) spaced 6 inches apart around the base provide the best way of injecting Ammate into the trunk. One tablespoonful, or 0.5 ounce is needed per cup.

The cost of Ammate is figured at 18 cents per pound, although it may be obtained much more cheaply in ton lots. Labor for cupping and applying the Ammate is about $0.80 for 50 trees 8 to 10 inches d.b.h. Thus the cost of poison and of labor for 50 trees is $1.90, comparable to the price of a good job of girdling.

Trees may be effectively treated with Ammate in summer, fall, and winter. The effect of Ammate is cumulative for at least three seasons. Many trees treated prior to 1946 sprouted foliage in 1946 and in 1947 but were completely dead late in 1947.

Though most work was with blackjack oak, other trees were treated. Sweetgum, blackgum, elm, ash, cypress, bay, willow, red oak, post oak, pin oak, and water oak are killed by Ammate about as readily as blackjack oak. Hickory, beech, persimmon, and white oak require a heavier dose and die more slowly.

Several owners of commercial forest tracts have begun to use Ammate on large-scale timber stand improvement and range betterment.

Artificial Range Revegetation

Range seeding studies are aimed at growing better forage plants, improving quality of grazing during midsummer, and development of firebreaks. Greatest success in establishing better forage plants on native range in Louisiana was obtained by a combination of fertilizing, burning to remove old growth, and harrowing to break the soil surface and to reduce competition. Good stands of common lespedeza were obtained by seeding and fertilizing alone. Carpetgrass and Dallis grass require burning the old rough, seeding, fertilizing, and springtooth harrowing for really good stands. On plots treated March 1946, Dallis grass showed up better in 1947 than in 1946.

Seeding and fertilizing produced good stands of Dallis grass, carpetgrass, and lespedeza under a heavy canopy of dead blackjack oaks poisoned in 1946 with Ammate. Such a site is well suited for reseeding to forage plants or regeneration to pines. There is little native herbaceous vegetation to contend with, and oak competition is eliminated.

Preliminary work in establishing firebreaks by seeding, fertilizing, and grazing has been successful. Quarter-mile strips fertilized and seeded in 1945 have been closely grazed during the last three years. Very little old growth (fuel) has accumulated except in isolated spots on the firebreak. Nearby unfertilized forest range was only moderately grazed and had ample remaining rough to feed a dangerous fire.

FOREST UTILIZATION SERVICE

The Forest Utilization Service continued to operate as a liaison between the Forest Products Laboratory and the timberland owners and the wood-using industries of the Southern Station territory. Problems of wood use from the standpoint of both the forest resource and available technical data on its utilization were explored with the purpose of aiding the development of a properly balanced and oriented program of research by the Forest Products Laboratory and local laboratories. Other activities of the Forest Utilization Service involve facilitating the flow of utilization information from the laboratories to the field, and suggesting and participating in pilot type tests of new utilization practices and processes.

Progress in 1947 is reflected in part by the type and direction of the Forest Products Laboratory program, a large portion of which was devoted to both fundamental and applied projects, directly or indirectly related to southern problems. The Forest Utilization Service also assisted local laboratories in formulating sound research programs. It aided many individuals and organizations by studying their problems and providing pertinent utilization information. Some of the more important projects which the Forest Utilization Service arranged for or participated in are described briefly in this report.

Wood Molasses

The possibilities afforded by the Madison Wood Sugar Process for the utilization of cull hardwood trees and woods and plant waste were explored. Arrangements were made for the Ozan Lumber Company of Prescott, Arkansas, to supply mixed mill-run oak slabs and southern pine slabs to the Forest Products Laboratory for conversion into wood molasses at the Madison pilot plant.

The pine molasses, having high fermentable sugar content, was tested by a commercial distillery in New Orleans to determine the conditions under which it could be used as raw material for commercial alcohol. Results indicated that pine molasses mixed with one-half to one-third blackstrap molasses can be used for commercial alcohol production with no significant alterations in procedure or decline in yield. With blackstrap molasses at nearly 30 cents a gallon in contrast to pine molasses at an estimated 10 cents a gallon or less, there are real possibilities of making a material saving for raw material in the distilling industry.

The hardwood molasses, because of its relatively high pentose content, is less useful for distilling than softwood molasses. A logical use, however, appears to be in the feeding of livestock. Annually, nearly 100,000,000 gallons of molasses are fed to livestock in the United States. This is only a small fraction of the amount which would be consumed if the feeding of molasses were practiced more widely. Therefore, in view of the tremendous possibilities in livestock feeding, hardwood molasses feeding trials were started. The molasses was fed to range cattle at the Alexandria Branch of this Station and to dairy cattle by the Department of Animal Husbandry, Mississippi State College.

The first tests have shown that the hardwood molasses is palatable to cattle. A second series of tests has been arranged to determine the nutritive value of molasses in comparison with corn. Some publicity along with discussions has stimulated widespread interest throughout the region in the possibilities of commercial wood molasses production. The interest is intensified during the present nation-wide grain shortage because of the possibilities of partially substituting molasses for grain in certain feeds.

Mine Detectors

Metal embedded in timber has always been a "sawyer's headache." Nails, horseshoes, turpentine hardware, bullets, wire--in fact, almost any kind of a metal article--may be found in a log, and generally causes trouble when the log is sawn.

This problem led to a study of the standard Army mine detector as a method of locating hidden metal. With preliminary tests elsewhere as a background, this Station conducted extensive studies and demonstrations which showed mine detectors to be practical under many conditions. Detectors can be used on large logs up to 28 inches in diameter. They can be used also on logs in water.

The Dantzler Lumber Company at Ten Mile, Mississippi, cooperated extensively in the mine detector tests. A full-time operator was hired and records were kept of the sawmill operation before and after using the detector. In the month previous to the detector's use, and in spite of the fact that a man on the deck looked for and chopped out all metal that he could find, metal caused 40 stops with the loss of 235 minutes. In the month after the use of the detector, metal was struck by the head saw only seven times, with the loss of 38 minutes, and this metal was in logs which had not been scanned with the detector. This company now uses the detector regularly.

Water Oak for Veneer

Water oak, which has often been bypassed for veneer, has been shown to be entirely suitable for this use. In 1946, the Forest Products Laboratory worked out methods of overcoming difficulties in cutting and drying. With these methods veneer of especially good quality was made. Much of it was suitable for furniture type plywood.

The Forest Products Laboratory made some of this material into plywood for testing as heads in special casks used by a New Orleans firm in importing palm oil. It turned out to be entirely suitable for this use. To answer questions as to its suitability for citrus-type containers, a number of test packing boxes were made by the Forest Products Laboratory. The Cummer-Graham Company of Beaumont, Texas, supplied a number of boxes from commercially cut pine and gum veneer as a base for comparison of performance qualities. The results of the tests, which were reported by R. S. Kurtenacker and K. E. Skidmore of the Forest Products Laboratory in the Christmas 1947 issue of the Southern Lumberman, show that containers made of water oak could be expected to give satisfactory performance under normal conditions.

Tension Wood in Cottonwood

Manufacturers of veneer from cottonwood find that a certain amount of the veneer buckles and "corrugates." Some of the veneer also gets fuzzy and splits. This condition is due to the presence of an abnormal type of wood fiber. Arrangements were made for the Forest Products Laboratory to make an exploratory study of this matter at the Greenville, Mississippi, plant of the Chicago Mill and Lumber Company. The specific purpose was to see whether the bolts containing significant quantities of these abnormal fibers could be sorted out in advance of cutting. Preliminary results indicated that present knowledge and experience were not sufficiently accurate to estimate the seriousness of the defect in the bolts. Additional work will be required in order to identify the abnormal fiber in visual examination of the bolts.

Air Seasoning

In August 1946, test lumber piles were installed by the Forest Products Laboratory at a commercial operator's plant in Memphis, Tennessee. The purpose was to determine, for 5/4 red oak, if vertically aligned two-inch flues distributed uniformly across the width of the pile produced better drying time and less checking than a small space between boards placed without regard to vertical alignment. A second objective was to study the effect of buffered sodium chloride on lumber which had been bulk-piled, after being treated with this material for a week prior to stacking. The experiment was completed early in the summer of 1947.

The air-drying rate of each group was practically identical, although the moisture content of the salt-treated lumber after air drying was about 1 percent higher than that of the untreated lumber. The checking in the pile with flues was about the same as, or possibly somewhat less than, the pile without vertically aligned flues. The checking of the salt-treated lumber was definitely less than that of the untreated lumber. The checking of the two top layers of all piles was considerably greater than that in any two layers lower in the pile, even though each pile was covered with the usual two layers of overlapping boards. No honeycombing was found when the lumber was cut after kiln drying.

A final report was written by Dr. Odell Julander, formerly of the University of Arkansas, on results of cooperative tests on the effect of buffered sodium chloride on seasoning of oak squares. The results indicated that there was little question that this treatment retarded checking. However, the checks in the untreated squares had closed at the end of the seasoning period, and, since standard grading rules do not recognize surface checks of this nature as defects, there was little difference in commercial grade between the treated and untreated squares. Dimethylol urea, which was also used in the test, showed no tendency to prevent checking.

Another test of buffered sodium chloride was made by the Bureau of Plant Industry, Soils, and Agricultural Engineering, Division of Forest Pathology. The object was to determine whether the material had any stain-preventing qualities. The test showed that it does not have sufficient fungicidal value to prevent stain and mold on susceptible species. However, adequate control can be obtained by the addition to the salt of a relatively small amount of sodium pentachlorophenate.

Log Grades

The Forest Utilization Service was represented on a Southern Log Grade Committee which was organized in the fall of 1946 to set up interim grades. The Committee prepared and issued a report giving specifications for log grades applicable to southern hardwoods and gave estimates of expectable lumber grade yields. The grading system was particularly directed toward forest surveys and appraisals. The grades have been adopted by the Forest Survey now in progress and by the national forests as one factor in determining log merchantability on timber sales. To perfect the grades, the Forest Products Laboratory carried on studies at southern sawmills during the year. Field work was completed. A comparison of the southern interim log grades with grades based on mill studies in the Central States showed a remarkably close conformance. The formulation of these grades is an important step forward in the whole process of timber quality evaluation.

Log Defects

Another phase of the work of the Interim Log Grade Committee had to do with classification and description of log defects. In cooperation with the Delta Branch and the Forest Products Laboratory, a comprehensive bulletin on this subject has been prepared. This bulletin will include a photograph and written description of all abnormalities visible on the log end or surface, together with a statement of the effect of each abnormality on log grade.

Fence Post Preservation

The Forest Utilization Service aided the Delta Branch in planning a series of experiments in the hot-and-cold-bath treatment of fence posts made from a variety of native hardwoods. Several years ago this Branch ran a series of experiments on treating local woods with hot-and-cold-creosote bath. These gave information on the relative ease of treatment of the different bottomland hardwood species. In the current test an oil solution of pentachlorophenol was used with eight of the species which previous tests had shown to be of some promise and which were known to be plentiful.

It was found that the absorption and penetration of "penta" dissolved in light petroleum oils are practically the same as with creosote diluted with fuel oil. This fact indicates that oils of the same viscosity will probably behave about the same whatever the toxic ingredient. There was some indication, however, that unless the same oil is used in both tanks sludge may form and be deposited in the outer pores of the wood. This may affect penetration adversely. The only heartwood that could be penetrated was that of honey locust. Sapwood of all species was penetrable, though at widely varying rates and distributions. The experiment with creosote convincingly established that cottonwood, willow, cypress, and soft maple will not treat economically. However, it seems safe to say that all other common alluvial bottomland species will treat well and economically on quite practicable time schedules.

In addition to the above treatment, peeled posts of cottonwood and willow were treated green by immersing them in chromated zinc chloride. Some green posts were also treated unpeeled by standing the butts in the solution. Dry posts were also treated. Analyses for salt content were made of borings from various designated places in a sample post from each test. It was found that both processes left the green wood heavily impregnated and presumably an effective and economical treating schedule could be developed for either method. Steeping dry wood does not seem at all promising. The absorption was much less than by the other two methods and distribution within the post much less uniform. It is questionable, of course, whether even the best salt treatment will pay in wet soils.

Following these treating studies, a service test was established. It includes 12 to 15 posts of each kind and class of post experimented with in pentachlorophenol and 5 of each salt treatment of each species involved. The total was about 230 posts.

The Forest Utilization Service also worked with the Forest Products Laboratory in treating and installing tests of pine and hardwood posts at the Harrison Experimental Forest. In this project, posts were treated green by diffusion methods. Also, posts were seasoned and treated by the cold soaking method. The object of this work is to see how effective a treatment can be obtained by simple methods, particularly those suitable for use by farmers.

In order to expand the work on fence post preservation testing, the Forest Utilization Service aided the Texas Forest Products Laboratory of the Texas Forest Service in planning a meeting of public agencies from the area west of the Mississippi River. As a result of this meeting a unified approach was adopted. The group agreed that all would test under a standardized procedure and that a systematic program of testing various methods would be followed. The first of these was the cold soaking treatment especially adapted to farmer use. A similar conference was held by the Tennessee Valley Authority early in the year. It included representatives from the States in this Station's territory east of the Mississippi River, as well as representatives from other States in the Tennessee Valley Authority territory. This meeting had results similar to the one in Texas.

The Forest Products Laboratory made the eleventh annual inspection of the test fence post line on the Harrison Experimental Forest. This continuing test, established in late 1936 and early 1937, includes 2400 pine posts and 26 different preservatives. The untreated controls had an average life of slightly over three years. Seven of the preservatives have had no failures or removals. The remaining 19 have had removals ranging from 1 to 65 percent of the total installation.

Strength Tests of Virginia Pine

The Forest Products Laboratory, at the request of the Forest Utilization Services at three eastern Stations, began a study of the strength properties of Virginia pine. Standard tests of the strength properties of green material were completed. The data indicate that the green wood is equal in most strength qualities to loblolly and shortleaf pine. Tests on dry materials are in progress.

Timber Transportation and Harvesting Problems

An analysis was made of the timber transportation and harvesting problems in the South in collaboration with the Forest Products Laboratory. The study indicated that the southern forest industries are by and large well aware of the necessity for improving their timber and transportation practices. So far as can be determined, progress of modernization is not directly attributable to lack of suitable equipment, of which there appears to be a reasonably adequate variety. Furthermore, new equipment is being constantly developed or adapted to a wider range of conditions, and old equipment is being improved.

The chief problems seem to be in directing the equipment development along simple, inexpensive, all-purpose lines. A great deal of testing and rating is needed to enable operators to choose the best equipment. Also, there is no adequate system for distributing information on presently available equipment, new developments and adaptations, or other pertinent information. To meet this last need the Forest Products Laboratory has arranged to issue data sheets on new development in this field. More than twenty of these are already published.

Forest Utilization Problems in North Arkansas

An analysis was made in the Arkansas Ozarks to determine the limitations imposed upon a sound forestry program by the existing utilization system. This work indicates that although there are many problems in forest utilization to be solved, particularly those involved in the removal of low-grade and cull trees, immediate progress in forestry will depend to a large degree on improvement in other factors. Currently, fire control appears to be the most outstanding of these. Average saw-timber quality is low, partly because of a long culling process with no provision for maintaining good growing stock, and partly because of unrestricted burning. There are, however, small lots of good timber tucked away in odd corners. During the war, high market values made it possible to market some of this. There is still a small volume of white oak suitable for staves, and this timber is now being marketed. Some of the area's specific forestry needs on which information is needed are:

1. Economics of killing cull trees.
2. Methods of producing sawed material from submerchantable trees.
3. Relation of growth rate to working qualities of oaks.
4. Accelerated drying schedules for oaks.
5. Possibilities of establishing a hardwood pulpwood-producing unit, with special reference to the problem of landownership.
6. Integrated logging.
7. Fence post service tests of second-growth cedar.

Alabama Mining Industry

Wood utilization problems in the mining industry of central Alabama were analyzed. This industry was chosen for study because of its direct and intimate influence on forestry in a large and important timber-growing area in the South. The conclusions are that timber growing and utilization are satisfactorily related in the operations of only two companies. The operation of 38 other large companies could be considerably improved by alterations in their wood procurement, forest management, and utilization practices.

Requirements for the same use vary considerably between different mines. One mine, for example, will use only a minimum amount of hardwoods for props; another will use large quantities. Unrestricted and poorly coordinated cutting, often the result of a contract or procurement system, leads to poor forest practice and great waste of material. For instance, trees suitable for lumber, ties, or timbers are split into props. Use of preservative treatments is inadequate throughout the industry. There appears to be an unnecessary multiplicity of sizes of material, some of which have little relation to use requirements. Coordination of the needs of procurement and the potential yields of the forest resource for full and integrated utilization, together with extension work on timber use, would unquestionably result in reduced drain on the forests, better forest practice, and considerable financial saving.

Seasoning

Using past work as a basis, the Forest Utilization Service and the Forest Products Laboratory worked out a long-range program of seasoning research for the South. The analysis made in this connection brought out the need for information on the economics of seasoning as a base for determining best practices and of comparing kiln-and air-drying. It also indicated that there is need for investigating new developments in seasoning.

An important aspect of the future research program in the South should be to study oaks in detail and to isolate the effect of species, locality, and growth rate on drying characteristics. A very important item which should be studied is the effect of closed surface checks on utility. Other items which showed up were the need for studying the use of electric moisture meters and the commercial application of end coatings. The analysis also indicated a great need for continuation of a strong educational effort on seasoning practices through a proposed kiln-drying manual, kiln courses, and a continuous stream of articles in trade journals. In order that field studies can be conducted on kiln-drying, the Forest Products Laboratory pilot kiln, which has been used in experiments at Memphis, Tennessee, was moved to Mississippi State College under a cooperative agreement with the Forestry Department there.

Survey of Wood Chemical Industries

In order to get first-hand information on the status and technical problems of forest industries using distillation and extractive processes, the Forest Products Laboratory and this Station cooperated in a survey which visited the following plants of the wood naval stores industry: Newport Industries, Oakdale, La., Pensacola, Fla., and Bay Minette, Ala.; Crosby Chemical Co., DeRidder, La.; Leach Bros., Columbia, Miss.; Continental Tar and Turpentine Co., Laurel, Miss.; Dixie Pine Products Co., Hattiesburg, Miss.; Hercules Powder Co., Hattiesburg, Miss.; Gulf Naval Stores, Gulfport, Miss.; Delta Pine Products, Covington, La.; and Alabama Naval Stores, Mobile, Ala. Plants of softwood destructive distillation industry which were surveyed were the Alexandria Pine Products, Alexandria, La., and the Termiteol Corp., Covington, La. Hardwood distillation industry surveys were made at Crossett Industries, Crossett, Ark., and Forest Products Chemicals, Memphis, Tenn. A comprehensive report on this survey is being prepared by the Forest

Products Laboratory. It stood out clearly, though, that the problems of the wood naval stores industries arise more from marketing difficulties than from technological complications. In fact, current technological improvements appear to be directed more toward reaching wider markets than toward facilitating production.

A very important and generally neglected possibility in the wood naval stores industry is the use of spent chips. These are used now by one company for low-grade wallboard; other plants burn them. The vast quantities of spent chips produced by these plants are an excellent potential source of material for wood hydrolysis plants. The wood is free from bark; it is clean; it is already chipped. Most of the plants could use natural gas for fuel instead of chips. As a source of wood sugar, the spent chips should be particularly interesting to distillers because of the large volumes involved and because of the high glucose content of the derived sugars. In the destructive distillation field, both hardwood and softwood, the conclusion seems inevitable that further research into the present basic processes is not justified. Rather, effort should be spent on developing new and more efficient types of processes.

Survey of Gas-Fired Kilns

There is a strong movement toward the use of gas-fired kilns throughout the territory where natural gas is available. In the last two or three years, installations have increased from one or two pilot models to close to 200 units. Accordingly, 29 operations with about 60 kiln units were visited for the purpose of observing their construction, procedures, and problems. These kilns appear to be less expensive to install, simpler to operate, and better adapted in general to small operations than steam kilns. They have exceedingly low fuel costs. On the other hand, very interesting claims are being made for these kilns, including such things as perfect drying with no humidity control, unusually fast schedules, better-textured products. The rapid rate at which gas-fired kilns are being installed makes it important that impartial and thorough studies be made at an early date to determine if these claims are justified.

Hickory Seasoning Survey

The Forest Products Laboratory and this Station cooperated in a study of the problems of seasoning southern hickory. The major difficulties are warp and twist, which develop where turned handles are kiln dried, and a discoloration known as "pinking," which degrades finished handles. A cooperative agreement with Mississippi State College, where the Forest Products Laboratory pilot kiln is now located, sets up the facilities for field study of these problems.

Dry-Kiln Schools

All analyses of seasoning problems indicate that there is a lag in applying known technology, particularly in the kiln-drying field. As an effective means of correcting this situation, the Forest Products Laboratory has, for many years, conducted demonstration schools both at Madison and in the field. In cooperation with the Southern Furniture Manufacturers Association, the first school in the territory of this Station was held in the fall of 1946 at Fort Smith, Ark. The second school was held at Memphis, Tenn., in April of 1947. The Southern Pine Association, the Southern Hardwood Producers, Inc., the National Hardwood Flooring Association, and the Tennessee State Department of Forestry cooperated in promoting the course. Kiln facilities and lumber for test-drying were supplied by Nickey Brothers Co. Attendance was about 35.

A third course was held in October 1947 at Lufkin, Texas. Cooperators in promoting the course were the Texas Forest Service and the Texas Lumber Manufacturers Association. The course was held at the Texas Forest Products Laboratory, which supplied kiln facilities and a classroom. Lumber for the test run was supplied by the Angelina Hardwood Sales, Inc. As a result of the interest aroused by this course, the Texas Forest Products Laboratory is sponsoring the formation of a dry-kiln club to discuss drying problems. Meetings are planned for every two months, starting January 15, 1948.

FLOOD CONTROL SURVEYS

Flood control survey work--under way at the Southern Station since 1937 but suspended in 1943 on account of the war--was resumed late in 1947.

This activity is pursuant to the Flood Control Act of 1936 and subsequent amending legislation which authorizes the Secretary of Agriculture to make examinations and surveys of watershed lands for soil erosion prevention and water-flow retardation in aid of flood control. Specific watersheds are assigned for survey to either the Forest Service or the Soil Conservation Service. Under the reactivated work program, the Southern Station is responsible for surveys of many of the major drainage basins in the territory extending from North Carolina to Texas and north to southern Missouri and Tennessee.

Flood control surveys usually involve two phases: (1) a preliminary examination to determine the need and general feasibility of watershed treatment for flood control, and (2) a detailed survey to formulate a plan of action to alleviate flood damage and to evaluate costs and benefits. The remedial plan may include such measures as intensified forest fire protection, tree planting, improved cropping and management practices, land use adjustments of various kinds, and small dams and other works to stabilize soil and reduce run-off. Survey reports which recommend Federal action are sent to Congress and provide the basis for authorization and funds to accomplish flood control work.

Previous Accomplishments

Prior to the war the Southern Station, assisted by the Soil Conservation Service and other agencies, made preliminary examinations of numerous watersheds and completed surveys of the Little Tallahatchie and Yazoo River basins in northern Mississippi. Survey recommendations for these two watersheds resulted in authorization, in the 1944 Flood Control Act, of some $26,000,000 of Federal funds for comprehensive programs of watershed improvement. These programs are now under way.

In addition, a detailed survey was substantially completed in 1942 for the upper White River in Arkansas and Missouri. From 1937 to 1942 the Station also assisted the Soil Conservation Service in forestry phases of flood control surveys for the Trinity, Grand (Neosho), Concho, Washita, middle Colorado, and lower Arkansas Rivers. Only a start has been made, however, in appraising flood problems and formulating recommendations for the greater part of the region served by the Southern Station.

EXPERIMENTAL FOREST DEVELOPMENT

East Texas

The Stephen F. Austin Experimental Forest is comprised of 2,500 acres of federally owned land and 1,200 acres of adjacent land leased from the Angelina County Lumber Company. These lands have been mapped, cruised, and organized for management. A road system has been partially constructed on the federally owned land. Also, a general improvement cut removing low-grade hardwoods for ties has been made on a large portion of the area. Reconstruction of an abandoned dwelling and installation of gas, water, and electricity have provided quarters for a resident manager on the experimental forest.

A second experimental forest, the San Jacinto, is also a part of the East Texas Branch. This experimental area is located within the Sam Houston National Forest. A silvicultural study was established on this area 10 years ago. This study is still maintained. In addition, the San Jacinto Experimental Forest provides opportunities for various kinds of extensive pilot studies which might be undertaken in the future.

Crossett

The Crossett Experimental Forest was unchanged in 1947. Considerable work was done in cruising and organizing Unit 2 (leased land) preparatory to installing a comprehensive study of silvicultural systems which are as yet untried on this experimental forest.

Ozark

In order to provide an accessible experimental forest typical of Ozark conditions, the Forest Service secured an option on a 750-acre tract of forest land 16 miles south of Harrison, Arkansas. Funds are available to close the deal as soon as the National Forest Reservation Commission acts on the recommendation to purchase. The action of the Commission is anticipated in early 1948.

Plans have been made for a rather large-scale improvement cut in 1948 on the Sylamore Experimental Forest.

Delta

The State of Mississippi continued the improvement of the Delta Experimental Forest. At the close of 1947 the large backlog of maintenance work which accumulated on the area during the war was pretty well completed. This work included graveling the main roads and constructing some heavy bridges. A cruise of the area and a management plan are scheduled for 1948.

Tallahatchie

Decision has been reached to request withdrawal of a portion of Holly Springs National Forest for an experimental forest. Informal arrangements with the Forest Supervisor have already been made to dedicate the land to this purpose. A soil survey and extensive timber survey have been completed on the proposed experimental forest.

Gulfcoast

Experimental cutting on a large scale was started on the McNeill Experimental Forest during 1947. At the Harrison Experimental Forest, developments were confined mostly to maintenance work and installation of comparatively small-scale studies.

Alexandria

Decision was reached during 1947 to abandon two of the units of the Palustris Experimental Forest which were badly damaged by the military during the war years. One other unit, the Johnson Tract, will be retained.

To supplement the Johnson Tract, an effort is being made to purchase suitable land now included in an abandoned military camp site. Included with the land is a small group of buildings that can be developed as an experimental forest headquarters. The purchase of the land and buildings from the War Assets Administration has in-Service approval. Final action on the land purchase depends on the deliberations of the National Forest Reservation Commission at its next meeting in early 1948.

Brewton

A lease which has been signed with the T. R. Miller Mill Company gives the Brewton Branch a block of land suitable for an experimental forest. This experimental area, known as the Escambia Experimental Forest, supports longleaf pine primarily. It is within 8 miles of Brewton on a main, hard-surfaced highway. A minimum of road construction will be needed, for all parts of the area are now readily accessible.

A 10-acre tract within the leased area has been donated to the Federal Government for development as an administrative site. No improvements have been made, nor has any experimental cutting been done.

Birmingham

Title has been conveyed to the Federal Government for 640 acres donated by the Sloss-Sheffield Coal and Iron Company. This land, together with ~~1,200~~ 1826 acres of adjacent land leased from the same company, comprises the Flat Top Experimental Forest. Improvement cutting was started on the forest during the year.

COOPERATING AGENCIES

Bureau of Plant Industry, Soils, and Agricultural Engineering

Products pathology

Control of stain, mold, and decay in green lumber.--Tests of new antiseptics were confined to materials that show promise as seasoning or insect control treatments. In cooperative tests with the Bureau of Entomology and Plant Quarantine, two of the newer insecticides, benzene hexachloride and DDT, proved relatively ineffective against sapstain, mold, and other fungus growth. The addition of pentachlorophenol in oil or sodium pentachlorophenate in water to the insecticidal solutions resulted in satisfactory fungus control. Apparently, one of the earlier-developed fungicides must be incorporated with these two insecticides for efficient fungus as well as insect control.

Urea proved fairly effective in preventing stain when used at the concentrations ordinarily employed for seasoning. An inorganic seasoning salt showed insufficient fungicidal value to warrant its use alone on stain-susceptible lumber. The addition of 0.48 percent sodium pentachlorophenate to the salt solution prevented objectionable staining in one test.

Loss of strength during use of certain common control solutions was found to vary with the chemical treatment and dipping practice. Recommendations were made that lumber dipping vats be replenished with usual strength solution before the vat level drops below 80 percent of the full working level. Such practice should be adequate for maintaining the effectiveness of the sapstain control solutions.

The heavy growth of Penicillium and Trichoderma molds on mercury- and fluoride-treated wood, respectively, appeared to be due to the high tolerance of these molds to the fungicides and to absence of competing organisms on the treated wood. The laboratory tests also indicated that small amounts of mercury may stimulate Penicillium development. These data help to explain the failure of certain treatments for uses in which mold control is important.

Building decay studies.--Three long-time tests were established of the effectiveness of improved joint designs and the use of on-the-job preservative treatments in preventing decay in exterior woodwork of buildings. These included (1) a series of full-sized exterior wooden steps of variable design with and without preservative treatment, (2) a comparison of preservative and preservative water repellent treatments in preventing decay in units simulating the joint of step rail and newel, and (3) an extensive series to answer some of the main questions that are raised about the use of on-the-job preservative applications for decay prevention in buildings.

An annual examination of previously established tests confirmed earlier indications that certain simple preservative treatments can be very helpful in building-decay prevention. Use was made of these results in supplying information or in making inspections requested by housing agencies and individuals troubled by decay problems.

Tree pathology

Fusiform rust of southern pines.--The standard spray (Bordeaux mixture with Santomerse), used heretofore to control rust in nurseries, was compared with seven new fungicides and adhesives in tests at the Ashe Nursery. One spray treatment a week for 10 weeks with Fermate, D-78, Goodrite Type 4, and Zerlate reduced fusiform rust infection to less than 3 percent, as compared to 5 percent for Bordeaux mixture and 12 to 16 percent for unsprayed controls. Ten weekly sprayings were almost as effective as fourteen twice-a-week sprayings followed by weekly applications. Seven sprayings, applied according to weather conditions, were somewhat inferior to the other two schedules. Phygon severely damaged seedlings in all cases. Fermate as a fungicide and Sterox as an adhesive and spreader showed greatest promise. Improved nursery control appears likely with one or more of the new solutions. Spraying recommendations that were mimeographed for distribution to tree nurseries last spring will be revised.

After two seasons in the field, a series of slash pine seedlings that originated from healthy, one-canker, and two-or-more canker parent trees showed 6, 18, and 11 percent, respectively, of the trees cankered. A second series of slash pine had 5.0, 7.7, and 10.5 percent, respectively, of the seedlings cankered when lifted for field planting in February 1947. In the same series the percentage of living seedlings with cankers after one growing season in the field was 0.8, 7.4, and 4.9, respectively.

The percentages of cankering among five geographic strains of slash pine after 4 years in the field were: Georgia (Pierce and Tift Counties) 17, Alabama 23, South Carolina 26, Louisiana 28, and Georgia (Clinch County) 28. The effect of an incendiary fire in February 1946 still tends to obliterate any inherent differences in susceptibility between the several strains. A more comprehensive comparison of slash pine from six geographic sources was initiated this year.

Fire induced an early break of dormancy in four additional plots that were established to study the relationship between burning and rust occurrence. The average needle length, in April or early May, for trees in well-burned plots, ranged from 1.7 to 1.9 times that of trees in unburned or lightly burned plots. Although the use of fire cannot be recommended for canker control, present evidence on increase of cankering does not justify advising against the prescribed burning of dangerous rough.

There was increasing evidence that rust damage can be minimized if dense stands are established and maintained. Data along this line were reported by both the Alexandria and Gulfcoast Branches of the Southern Forest Experiment Station. Similar differences in favor of the denser planting were recorded in a comparison of cankering in 9.3-foot by 9.3-foot versus 4.6-foot by 4.6-foot plantations of slash pine 7 years of age, on the Harrison Experimental Forest.

Nursery diseases.--Exploratory tests of 16 fungicidal soil treatments were established at the Ashe Nursery for the control of root rot in slash and longleaf pine. Preliminary indications were that formaldehyde and Isco AA significantly increased the thriftiness and stand of seedlings, and that Isco AA had striking possibilities as a weed control treatment as well.

New diseases.--The pitch canker disease, now being investigated by pathologists in the southeastern region, was found attacking slash and longleaf pine in southern Alabama. The distribution of the disease and the extent of damage were limited.

Bureau of Entomology and Plant Quarantine

Pine sawfly in southern Arkansas

During 1947, an experimental spraying program was conducted in Arkansas for the control of the pine sawfly (Neodiprion sp., possibly pinus-rigida) by aircraft application of DDT. Four plots approximately 100 acres in area were sprayed, using 1/2 and 1 pound of DDT in 1 and 2 gallons of solution per acre. The plane flew at a height of about 50 feet above the tree tops, and a swath width approaching 100 feet was obtained. Considering the makeshift equipment used, the spray pattern and particle size were fairly satisfactory. Greater uniformity would undoubtedly have been obtained if the plane had been equipped with proper spray apparatus, including a by-pass valve in the delivery unit and nozzles on the spray boom.

Control of the sawfly larvae was effective, though the great natural decrease in the severity of the epidemic condition made impossible an accurate evaluation of the effectiveness of the different dosages used. Larval mortality was evident within a period of 24 hours in the case of small larvae feeding in the top of mature trees. Larvae approaching maturity were more resistant to the spray and lived up to 5 days, though they fed very little.

Reports of the presence of considerable sawfly activity in southern Arkansas were received about 1940. It seems quite likely that there existed endemic infestations of Le Conte's sawfly in the same area occupied by Neodiprion sp. This may explain why Le Conte's sawfly, conspicuous and easily identified, was regarded as the insect responsible for widespread defoliation of mature timber which took place in the following 6 years. In 1945 a survey of the defoliated area was made by this Station and plans were laid for aircraft spraying with DDT and lead arsenate. Shortly before spraying the program was dropped because of the fear of landowners regarding toxicity of DDT to warm-blooded animals. Following the severe defoliation of 1946, several conferences between timber operators, the Southern Station, the Arkansas Forestry Commission, and this unit led to the aircraft spraying program of April 1947.

In February 1947, counts were made of the cocoon population in the soil of areas heavily defoliated in 1946. The generally low count suggested a declining epidemic condition. Defoliation in the spring of 1947 occurred only in scattered areas and was not nearly so severe as that of other years. A cocoon count made in May 1947, under a severely defoliated pine plantation, yielded, roughly, an average of about eighty cocoons per square foot of soil. In September, it was impossible to find a single cocoon in any of about ten observation points in the same area. The soil in the entire area was heavily burrowed as a result of activity of rodents which undoubtedly are responsible for wiping out the cocoons. The predaceous calasoma beetle was frequently found in the soil. Thus, it appears likely that due to build-up of predators, parasites, and larval diseases, sawfly infestation will probably be less severe in the coming year than it was last year and may largely occur on the fringes of areas most recently occupied by the insect.

Oak leaf-miner

An experiment in the aerial application of DDT for the control of the oak leaf-miner (Baliosus ruber) was conducted in late June 1947, in cooperation with the Chicago Mill and Lumber Company of Tallulah, Louisiana. Observations made by research personnel of this company indicate that the miner has been causing severe defoliation of red and overcup oaks over a large area of northeastern Louisiana. Death of scattered trees has occurred. It is quite possible that several years' defoliations by the insect, combined with damage by ice storm during late winter in 1947, may have encouraged attack and killing by Agrilus bilineatus. Defoliation of some severity has been occurring since 1942, though it was not until 1947 that the lumber company officials showed concern and a report was made to this Station. A test of the value of aerial spraying was requested, the company assuming all obligations in this connection. Recommendations and technical supervision were provided by entomologists of this Station. Unfortunately, personnel was unavailable to carry on basic studies to determine cause of tree mortaility and the importance of Baliosus ruber in this regard.

Treatment was directed at adults, and application was made during the peak emergence of the first generation. Applications were made to three 50-acre plots at the rate of approximately 3/4 and 1-1/4 pounds of DDT per gallon of solution per acre and 1 pound of DDT per 2 gallons per acre.

Counts from collection trays revealed that large numbers of beetles were killed by the DDT sprays. Unfortunately, however, the infestation was much lighter and more scattered than that of previous years, so that it was impossible to evaluate properly the effectiveness of the different dosages used. It is not known whether natural control depleted the beetle populations or whether abnormal weather conditions temporarily upset normal activities of the insect.

Preservation--Wood and wood products

Inspections were made of sections of trees impregnated with water soluble chemicals and placed in service 7 and 12 years ago. These trees were treated by sapstream methods of injection and placed in service tests at the Harrison Experimental Forest in 1935 and 1940. Very little change has taken place since last year's examination. It appears that where termite activity is present, it is largely confined to the surface. Penetration becomes deeper as leaching of the chemical occurs.

A series of lumber dipping tests was established in Mississippi and the Canal Zone to determine the value of various chemicals in protecting wood against termite attack. Dips of various time durations were made in a number of chemicals, among them being several on which the War Department requested a test. Examination of the tests after exposure of 13 months in the Canal Zone and 8 months in Mississippi has recently been made. Instantaneous dips appear to have little value except in a few cases. The naphthenates, pentachlorophenol, and benzene hexachloride have offered excellent protection to date.

Tests of resistance of building materials to termite attack have been made in cooperation with the Housing and Home Finance Agency and Forest Products Laboratory. Among materials tested were panels consisting of impregnated cores of honey-comb kraft paper faced with aluminum sheeting; impregnations were with different types of phenolic resins. Also tested were wall boards and roof construction materials made by impregnating excelsior, palmetto pulp, and paper with inorganic and organic chemicals and binders.

These products were exposed to termite attack in accelerated tests. None were found to be resistant.

Following these tests, samples were treated with such materials as pentachlorophenol, copper naphthenate, monochloronaphthalene, DDT, and other chemicals. These treatments appear to be effective in repelling termite attack in accelerated tests.

Ambrosia beetles

A large number of small-scale tests have been conducted to determine the value of insecticides, particularly recently developed organics, in protecting green hardwood logs from ambrosia beetle attack. Among these chemicals are benzene hexachloride, DDT, methoxy-DDT, chlordane, and toxaphene. Preliminary results indicate that benzene hexachloride, used at a concentration of 0.48 gamma isomers (by weight) continues to be the most effective. None of the other chemicals appear to possess sufficient merit for use on a practical scale.

Tests of water-dispersible materials used with green lumber indicate that both benzene hexachloride and DDT are very effective in preventing ambrosia beetle attack.

Preliminary tests conducted cooperatively with Forest Pathology were made to determine compatibility of wettable DDT and benzene hexachloride with fungicides commonly used for stain prevention. Compatibility was positive in all cases. The insecticides did not influence the effectiveness of the fungicides. Later tests in the field showed that DDT and benzene hexachloride were compatible with pentachlorophenol in oil solutions and with Dow G, Lignasan, and Permatox 10 S in water preparations. In no case was the insecticidal or fungicidal effect of the materials influenced by mixture.

The consistently favorable results obtained with benzene hexachloride necessitated a large-scale test to determine its effectiveness and practicability under actual operating conditions. Decks of logs were sprayed at banking yards of two different mills; tests included the complete spraying of logs prior to decking and the spraying of entire decks. Preliminary observations indicate quite definitely that spraying of entire decks, by present spraying methods, is not effective. Individual logs must be sprayed and completely wetted if ambrosia beetle attack is to be prevented.

Subterranean termite control

Examinations were made of standardized soil poison tests at Beltsville, Maryland; Saucier, Mississippi; and the Canal Zone. Results from these show that sodium arsenite, though restrictive in application, is the most effective of all poisons used. Pentachlorophenol is somewhat less effective; lead arsenate continues surprisingly good; and creosote and kerosene and the chlorinated benzenes appear to be quite erratic.

Examinations have been made of platform tests established 18 months ago. These were designed to test the value of light surface applications of soil poisons in protecting materials under temporary storage. Protection for a 12-month period is considered good. Sodium arsenite has offered excellent protection for 18 months in all dosages used: 1/4, 1/2, and 1 pint per square foot. Benzene hexachloride and DDT in oil offer good protection for 18 months in the higher dosages.

Dry-wood termite control

Tests were conducted at Key West Barracks, Key West, Florida, for the control of dry-wood termites. Holes were drilled into wall timbers and liquid chemicals injected under pressure. This method is feasible under certain conditions because of the termite's habit of making small, scattered excavations connected by narrow galleries. Orthodichlorobenzene, pentachlorophenol, DDT, chlordane, benzene hexachloride, and acetylene tetrachloride were used.

Examination was made and measures recommended for the control of dry-wood termites in the Weather Bureau building at Key West. Every unit of wood in this building, including floors, framing, doors, furniture, and stairways, was heavily infested by termites. This building will be kept under observation in order to determine effectiveness of control measures applied.

PLANS FOR 1948

FOREST MANAGEMENT
(Including Forest Influences)

General

An analysis of the results of a thinning study in slash pine in south Georgia will be completed. This study, now abandoned because of unauthorized cutting, was carried on by the Southern Station before Georgia was transferred to the territory of the Southeastern Station. The results of this and other thinning studies made at the Southern Station will provide the basis for a comprehensive report to be prepared later. An analysis of pine log-and tree-grade criteria most highly correlated with lumber values will be made. The revision of Technical Bulletin 492, "Artificial Reforestation in the Southern Pine Region," will be submitted for review in the first half of 1948. The regeneration project analysis will be revised to fit the needs of the branch program.

Alexandria

Establishment of pine plantations

Studies of direct seeding of longleaf and slash pines and conversion of scrub oak stands to longleaf and slash pine will be established. Observations preliminary to detailed studies will be made on methods of stimulating early height growth of planted longleaf pine, choice of pine species for planting on cut-over longleaf pine land, and the comparative effectiveness and costs of mechanical and hand planting.

Management of pine plantations

The project analysis will be completed. Thinning studies will be started in a 13-year-old slash pine spacing plantation of 40 acres in the Palustris Experimental Forest, and in a 20-year-old loblolly spacing plantation of 40 acres in the Alexandria State Forest. Pulpwood thinnings to various degrees of intensity will be tested in these studies. Plans will be made for thinnings in 20-year-old slash pine plantations, in cooperation with a private company.

Birmingham

Improvement of depleted stands

Cutting will be completed in a study of methods of improving depleted stands. The residual stands will be measured. A working plan will be prepared for a study of pine seed production and dissemination. Preliminary tests of underplanting and release will be started, using both loblolly and slash pines.

Management for alternative products

The project analysis will be completed and one or two studies will be initiated. Tentatively, it appears that a study should be made concerning the feasibility of short rotations to produce mine props. Another may be a comparison of the effect of different lengths of cutting cycles on yield of saw-timber and other products.

Brewton

Management alternatives for longleaf pine

The project analysis will be completed and a working plan prepared for the first study. Three rotation-product alternatives and two silvicultural systems probably will be tested in this study.

Regeneration of longleaf pine

The scrub oak control study established in 1947 will be reexamined to determine the effectiveness of each method and to weigh effectiveness against cost.

Intermediate management of longleaf pine

The project analysis will be made, and the first new study installed if possible. The 15-year reexamination of a series of intensity of thinning plots in south Alabama will be made after the 1948 growing season.

Crossett

Comparison of management systems

The working plan for a large-scale study comparing productivity and net returns from seed-tree, group-selection, and single-tree selection systems, each on 30- and 60-year rotations or their equivalent, will be completed and the study initiated.

Natural reproduction

The study of the development of seedlings from the 1939 seed crop in relation to size of overstory opening will be revised to include several additional important factors--especially the effect of competition from low hardwood brush. To get additional information on the separate effects of moisture and light, a small study involving watering, trenching, and removal of competitors will be established. Remeasurements of the 1937 and 1942 methods-of-cutting plots will be made and a progress report prepared. An annual burning study at Urania, Louisiana, will also be remeasured and reported.

Control and management of upland hardwoods

A project analysis will be made to determine the next studies needed in this increasingly important field. Two articles on the effect of different degrees of release of pine reproduction under low-grade hardwoods will be prepared. Remeasurements of improvement cutting studies at Urania, Louisiana, will be made and progress reports prepared. The 1947 study of costs and effectiveness of cutting and girdling versus poisoning with Ammate in removing or reducing competition by undesirable hardwoods will be reexamined after the 1948 growing season to determine the extent of mortality and sprouting. Effectiveness will be weighed against costs. An article on the use of fire in controlling small undesirable hardwoods will be prepared. A study on this subject has been in progress since 1940.

Management of young pine stands

Two articles covering the results of old-field thinning studies at Crossett and Urania will be prepared. These will indicate the types of thinning necessary for greatest quality and quantity production. Progress reports will be prepared for the six thinning studies at Urania, Louisiana. Pruning studies at Crossett and Urania will be examined to determine results to date and whether additional unpruned trees need to be removed from the stands.

Delta

Cottonwood planting

A project analysis will summarize progress to date and guide future work. In view of the obvious need for cheaper methods of reducing competition of weeds, vines, and other trees in cottonwood plantations, tests of several recently developed chemical weed-killers will be made, and their effectiveness and cost compared with hoeing and fertilizing. Tests of cuttings held in cold storage until well into the growing season will be continued, since several years' experience is needed before reliable conclusions can be drawn. Progress reports will be prepared on current studies of the production of nursery-grown cuttings, site preparation before planting, and the salvage of weak and poorly formed trees.

Management of depleted stands

The project analysis will be completed, together with a master working plan for the first major study and a separate working plan for the first three plots. These plots will be given improvement cuttings and the data analyzed as a guide to further installations and cuttings. The 1946 and 1947 tree-poisoning tests will be reexamined and progress reports prepared.

Growth and development of well-stocked stands

The project analysis will be prepared and the first recommended study will be started by establishing one or more permanent sample plots.

Management of commercial stands

Cutting of the plots already laid out in a cooperative study in a commercial stand will be completed, and the remaining plots called for by the working plan will be installed if possible. The balance of the logging on the tract will be supervised and closely observed as a basis for one or more articles on the actual operation of good management practices. A management plan will be worked out for a second cooperative study and assistance provided for putting it into operation, following the policy of studying forest management problems at first hand by practical application on specific tracts.

Gulfcoast

Management of commercial longleaf-slash pine stands

The project analysis will be revised. Progress reports will be prepared on the 1947 logging at the McNeill Experimental Forest and the McNeill and the Harrison Experimental Forest growth plots. A working plan will be prepared for a longleaf growth study.

Cruising and cutting will be continued in the large-scale McNeill study. Improvement and release cuttings will be started in the bottomland type and where pine is suppressed by low-grade upland hardwoods. A small-scale study of growth of sapling longleaf pine following release from overstory trees will be installed. Current pruning studies will be reexamined and a progress report prepared.

Effect of fire in longleaf pine

A project analysis will be prepared. An office report and two articles will be prepared on completed studies of the effects of fire on longleaf reproduction.

A study of age at which longleaf pine becomes fire resistant will be started in the abundant natural stands from the 1947 seed crop. Current growth and mortality plots will be remeasured. The extensive study of stimulation of height growth by prescribed burning will be reexamined. Survival records will be taken on the joint seedbed preparation-tree percent (tree seed production and percent of surviving seedlings) study. Field data will be summarized and reported. Fire exclusion areas will be examined and an establishment report prepared. Analysis of growth data from an old Dry Prong, Louisiana, study will be started.

Regeneration of longleaf pine

A working plan for a seed study and office reports on nutrition, tree percent, and Ashe Nursery studies will be prepared. Current studies in these fields will be continued. New studies of the stimulation of seed production in second-growth longleaf, longleaf seed sources, and competition and site preparation will be started.

Fusiform rust of southern pines

A project analysis will be prepared. Current studies in longleaf and slash plantations set out in 1936 will be continued and a progress report prepared.

Tallahatchie

Improvement of depleted hardwood stands

A project analysis will be prepared following additional field observations on the extent of various forest conditions and their response to different treatments.

Forest establishment on abandoned and eroding lands

The project analysis will be prepared, following further observations. An office report and one or more articles on the Madison County, Tennessee, plantations will be prepared.

Stabilization of gullies and bare areas

The project analysis will be completed. An office report on recently examined erosion control plantings will be prepared, following completion of the current analysis of data. Small grass and legume test plantings started in 1947 will be reexamined and extended, and a progress report will be prepared.

Rehabilitation of forest soils

The project analysis will be completed, and a working plan prepared for the first study of vegetative succession and soil characteristics on abandoned land that is reverting to forest.

East Texas

Improvement of depleted pine-hardwood stands

The project analysis will be completed. Establishment of the study of various intensities of release cutting started in 1947 will be completed, and mortality and sprouting of treated hardwoods will be recorded after the 1948 growing season.

Management of commercial pine stands

The project analysis will be completed, a working plan for the first study prepared, and the study initiated. The San Jacinto methods-of-cutting study established in 1938 will be completely remeasured and further cuttings made in four of the eight treatments. A progress report will be prepared after the data are analyzed. The trees in the associated study of growth and mortality of individual trees will also be remeasured and results reported.

Management of bottomland hardwoods

The project analysis and a working plan for the first study will be prepared. Plots testing different types and degrees of cutting will be laid out and marked.

Ozark

Management of eastern redcedar

Volume tables and preliminary stand and stock tables for well-stocked natural stands on sites II and III will be prepared. An office report on the redcedar reconnaissance survey will be prepared. Field work in the two cutting studies will be completed and office reports prepared.

Improvement of inferior hardwood stands

Analysis of the study of site factors influencing the growth of oak will be completed, an office report prepared, and work started on a publication. The study is being made in cooperation with the University of Arkansas.

Thinning of hardwood stands

Stand improvement plots established on the Sylamore Experimental Forest in 1934 will be treated again. All measurements to date will be analyzed, and an office report prepared.

Management of upland hardwoods

In cooperation with the Ozark National Forest, a reconnaissance survey on the Sylamore Experimental Forest will be planned and made. It will be followed up by a needed improvement cutting over most of the area.

Norris-Doxey Farm Forestry

Mississippi

A working plan will be completed and field work started in a study of growth and yield in the pine and pine-hardwood stands in the flatwoods soil province of northeastern Mississippi.

Alabama

The working plan will be completed and field work started in a study of the costs and returns of good farm forest management in central Alabama. A separate management plan will be prepared for each farm woodland included in the study.

FOREST ECONOMICS

General

Atlas of forest-economic information

To help meet continual requests for forest-resource, forest-industry, and other forest-economic data for the South, the Southern Station, in cooperation with the Southeastern Forest Experiment Station, will release an "Atlas of forest-economic information" for twelve southern states from Virginia to Texas. Copies will be put in the hands of public and private groups who make frequent use of such data. The atlas will be bound in looseleaf style so that additional tables, maps, and charts, to be released from time to time, may be inserted to keep the atlas up to date.

Regional problem analysis

An office report on regional economic problems in forestry will be completed. Incorporated in this statement will be a review of the research done on these problems in years past and an appraisal of future research needs.

Forest Resource Analysis

Forest landownership and management in central Mississippi

Having completed the field work on this study, the Station will begin immediately to compile and analyze the field data in an office report. Early completion of a final report is also planned.

Forest situation in Mississippi

A Forest Survey analytical report on the forest resources and industries of Mississippi will be begun and largely completed during 1948. Supplemental studies will be made of forest landownership and management; industrial competition, utilization, and trends in timber quality; income and employment; and other economic data. Results of these studies will be combined with other findings of the Forest Survey. The preliminary draft of the report is scheduled for completion early in 1949.

Land use in southwest Louisiana

The report on the economic study of planted pines and cattle grazing in southwest Louisiana will be completed jointly with Range Research and submitted for publication as a bulletin.

Forest Resource Inventory

Timber resources of northwest Arkansas

The Forest Survey field inventory of northwest Arkansas will be completed in early spring. Data on forest area and timber volume, together with a forest-type map of the district, will be released by mid-year.

Timber resources of Mississippi

Forest Survey cruisers will return to Mississippi after their work is done in northwest Arkansas. They will cover the northeastern part of the State (Unit 2) by June 1 and the southeastern part (Unit 4) by August 1. A statistical report on forest area and timber volume, growth, and drain in Mississippi will be released late in the year.

Timber resources of Tennessee

If appropriations are made for work in previously unsurveyed territory in fiscal year 1949, the Forest Survey will enter Tennessee after field work is finished in Mississippi--about the first of August. The cruising teams will work within the State during the balance of 1948.

Economics of Forest Management

Evaluating management alternatives

A project analysis will be made in order to break this broad project down into classified problems and to define each as a study. Studies of a basic nature will be made first. For example, studies of interest rates, of values of individual trees of various sizes for alternative products, and of optimum volumes of growing stock for greatest net returns will be made and reported upon.

Intensive timber management

A detailed analysis and office report of the results to date in the 10-year-old cutting cycle study at Crossett are planned in 1948.

Two project analyses are planned in the general field of the economics of intensive timber management: (1) A project in east Texas designed to compare returns from the utilization of alternative products from the forest; (2) a project at the Alexandria Branch to evaluate and compare the returns from intensive timber management with the returns from grazing and timber management combined.

Intensive management of farm woodlands

The financial aspects of intensive management of small properties will be in progress at seven Branch Stations this year. These projects are continuous in that they involve annual treatments for an indefinite period, but except for Crossett, which has a 10-year cutting record, none of these projects has more than one year's cutting record to date. The Gulfcoast Branch plans to begin a comparison of the cost of growing fence posts from decay-resistant species and the cost of using treated posts of pine obtained in thinnings. The Brewton Branch plans to survey the management of small forested properties in its territory as well as to install a study on its experimental forest.

Forest Industry Analysis

Mississippi forest industries

Data from the Forest Survey on Mississippi's wood-using plants and operations will be interpreted and released as a Survey report.

Lumber industry

An analytical report on sawmills and sawlog and lumber production, based on data from the 1946 lumber census, will be prepared.

Pulpwood production

A report will be released on the production and movement of pulpwood in the Station's territory. Data for the report were gathered in recent Forest Survey canvasses.

Costs and woods waste in round mine-prop production

To permit a sound cost analysis, the mine-prop study, which was made in Alabama during 1947, will be supplemented with additional data. A report will be prepared in 1948.

Unit package loading of pulpwood and chemical wood

This study, which was made at Crossett last year, will be expanded during 1948 and analyzed in an office report.

Small lumber-mill realization values

Realization values from the sawing of pine lumber in east Texas from logs of different sizes and grades will be published as an Occasional Paper during 1948. A similar study is planned for hardwood species either in 1948 or early 1949.

Integrated utilization for mine props and mine ties

The Birmingham Branch will undertake a study of the economics of cutting ties and different lengths of mine props from a given area as compared to the customary practice of cutting only one kind or size of product.

Short- versus long-length logging

Field data collected in 1947 at Crossett, comparing the costs of logging with logs of different lengths, will be analyzed in an office report. The skidding and loading phases of the study may be repeated in the field, using equipment better adapted to handling long logs than that previously available.

Forest Industry Inventory

Timber drain in Mississippi

The results of the studies of timber production and utilization in Mississippi in 1946 will be worked into the form of drain estimates. The data will be released as part of the general Forest Survey statistical report for Mississippi, due to be completed late in the year.

1947 pulpwood production

A survey will be made of pulpwood production and movement throughout the Station's territory.

RANGE RESEARCH

General

A regional project analysis for artificial revegetation studies involving the three Coastal Plain branches is scheduled for completion in 1948. Plans for range research work at the branches follow.

Alexandria

Grazing management

A project analysis will be prepared to cover both the forage and livestock management phases. The Louisiana forage study results will be summarized for publication.

The working plan will be revised in final form for the study on identification of important forage plants, on which the Washington Office is cooperating. About 100 of the most important range forage plants in central Louisiana will be described and illustrated in a small, practical field manual.

The preliminary study of methods of measuring forage was carried out under drought conditions in 1947. It is to be repeated in 1948.

The winter-feeding study is to run for at least two more years, according to approved working plan. The two special feeding pastures were increased from 160 to 320 acres, and a greater spread in rations is planned. Cattle weight data will be set up on IBM cards.

Field work on the hog damage study will consist mainly of measuring new damage on the 1947 plots. A working plan for a more fundamental study will be prepared after the 1948 measurements have been made. One technical and one popular article are planned.

Control of low-value hardwoods

The initial study on chemical control of undesirable hardwoods is essentially complete except for final examinations and reports on the past three years' results. A project analysis will be prepared to determine future course of this work.

Artificial revegetation

Project analysis will be prepared in the New Orleans office. The main Branch work will be to evaluate past preliminary results and to prepare a working plan for the proposed study on establishing and grazing firebreaks. Routine tests will be initiated on survival and production of plants recommended by the BPISAE and SCS. Blackjack oak control plots will be seeded with lespedeza, carpetgrass, and Dallis grass.

Gulfcoast

Grazing management

The start of cattle grazing on the McNeill Forest pastures is contingent on funds for fence construction and on final arrangements with the Mississippi Agricultural Experiment Station for cattle and facilities to handle them. Forage production estimates and chemical analysis of samples will be continued, along with a forage inventory to follow effects of timber cutting and burning on selected 40-acre compartments.

Sheep damage study results will be prepared for publication.

Artificial revegetation

Tests of species and methods for piney woods seeding are to be continued. These tests were begun late in 1947 in cooperation with the BPISAE and Mississippi Agricultural Experiment Station.

Brewton

Grazing management

Project analysis will be continued during 1948 and will include a survey of range management practices and problems in south Alabama and west Florida. County agricultural workers will be consulted for first-hand knowledge of forest grazing conditions and problems needing study.

Artificial revegetation

Limited seeding and fertilizing tests will be made in connection with the firebreak study listed under Forest Management.

Ozark

Grazing management

The forage study started in 1947 will be continued according to approved working plan, including collection and analysis of forage samples. Data for 1947 and 1948 will be included in an office report. It is planned to prepare a first draft of a publication describing forest range forage conditions in the Ozarks, incorporating data collected in the 1946 forest farm reconnaissance as well as that obtained in the forage study.

Deer forage management

The deer forage utilization study will be held to a minimum with collection of data and preparation of reports on the Sylamore District of the Ozark National Forest, according to the approved working plan.

FOREST UTILIZATION SERVICE

The efforts of the Forest Utilization Service in 1948 at improving utilization practices and guiding research will include surveys of sawmill waste in relation to utilization alternatives, hickory utilization, the southern veneer and plywood industry, and the dimension stock industry. Continued attention will be devoted to problems of mechanization, especially the debarking of wood. Strong emphasis will be placed on the use of wood molasses for livestock feeding.

Specific studies of the volumetric aspect of waste and of operation of gas- and oil-fired kilns will be made. Continued cooperation will be extended to the Forest Products Laboratory, particularly in studies of preservation treatments, kiln-drying of refractory species, and hardwood log grades. General assistance will be extended to both public and private concerns, as in the past, with the exception that greater emphasis will be placed on working with research and extension groups. The Forest Utilization Service will also act as technical advisor on utilization problems to the other divisions and branches of the Southern Station.

FLOOD CONTROL SURVEYS

The immediate jobs for the coming year are to (1) complete the survey of the upper White River watershed, and (2) survey the Homochitto-Buffalo River watershed in southwestern Mississippi. Of high priority, after July 1, are surveys of the Ouachita and lower White Rivers in Arkansas. The Soil Conservation Service also needs assistance in forestry phases of flood control surveys assigned to that agency--chiefly in the southeastern States where surveys of the Savannah River watershed and other major basins are scheduled at an early date. The Station will also participate in formal reviews of several survey reports that are nearing completion.

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TWENTY-EIGHTH ANNUAL REPORT

1948

FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

SOUTHERN FOREST EXPERIMENT STATION
Chas. A. Connaughton, Director
New Orleans, La.

(OAKLAND-12-18-47-5,000)

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TWENTY-EIGHTH ANNUAL REPORT

SOUTHERN FOREST EXPERIMENT STATION

1 9 4 8

INTRODUCTION

In 1948, the program of the Southern Forest Experiment Station settled into a more or less normal pattern for the first time since the prewar defense efforts disrupted activities. Of course, the program was considerably different from that of prewar years, but barring unforeseen emergencies it is one which should be followed fairly closely for several years in the future.

By the end of the year, the reestablished Forest Survey was operating on a firm schedule according to tried and proven plans. The Division of Flood Control Surveys was revived and doing the job which was suspended during the war. Project research, both regionally and at the branch stations, was past the hurdle of preliminary planning and organization necessitated by its recent expansion and had settled into the action phases. The new Division of Range Research and the Forest Utilization Service had found their true places in the broad program and were carrying out their responsibilities. Furthermore, the backlog of recurrent observations, measurements, and compilations which had been postponed during the war was pretty well out of the way.

The results obtained by this more or less normal program as currently operating are the subject of this report, together with a brief statement of plans for the coming year. As a supplement to the body of this report, the attached list of publications should be reviewed and the articles consulted for more detailed accounts of many phases of completed work.

RESULTS

FOREST MANAGEMENT
(Including Forest Influences)

Regeneration

Cleaning and storing pine seed

Using water to float off the trash effectively cleans southern pine seed (except longleaf), but may leave the seed too moist for long storage. To determine the harmful effects of cleaning by wetting, and the beneficial effects of sun drying, a small but rigorous study of slash pine seed from the 1947 seed crop was made. The freshly extracted seed was cleaned in two ways, by dry fanning and by quick flotation in water. Half of each of the two lots was exposed in a shallow layer in the shade for a day, and then stored. The other half of each lot was exposed in shallow layers in the sun on three days, and kept in air-tight tins between sunnings. Half of each of the four resulting lots was stored at air temperature and half at 38° F. (all in sealed containers) from about November 1 through February 28. Thirty-day germination percentages are presented in table 1.

Table 1.--Effect on germination of various methods of cleaning and storing slash pine seed

Method of cleaning	Over-winter storage temperature	Germination of seed-- Dried 3 days in sun before storage	Germination of seed-- Dried 1 day in shade before storage
		- - - Percent	- - -
Fanned:			
Seed moderately	38° F.	61	66
moist before drying	Indoor air	58	55
Floated:			
Seed very moist	38° F.	67	83
before drying	Indoor air	66	0

Sunning did not injure any of the lots of seed tested. It preserved seed over-winter even after the seed had been moistened excessively during cleaning and was subsequently stored at air temperature. Seed unsunned but comparably cleaned and stored spoiled completely. When seed cleaned by floating was not sunned, refrigeration was required to keep it alive for the 4-month period. These results should be useful to collectors and extractors who lack equipment for weighing and drying seed to learn the moisture content, but who can use a treatment such as this.

"Stratification" (chilling in contact with a moist medium) has been used for 20 years to increase and especially to hasten the germination of southern pine seed. Early investigators recommended 30 to 90 days of stratification. Practical experience later indicated that more than 45 might be risky with large seed lots, and 30 days has been accepted as more or less standard treatment. Two nurseries have stratified seed for 16 to 20 days with good results and a couple of small tests have indicated good results from as few as 8 days of stratification of slash pine seed.

With a lot of fresh slash pine seed tested in the spring of 1948, even 1 to 3 days' stratification produced appreciable benefits, and for all practical purposes 8 days' stratification was as good as 20. With a lot of loblolly pine seed stored 1 year at 38° F. and tested in the spring of 1948, 8 days of stratification about doubled the germination obtained during the first 8 to 11 days after sowing, as compared to that of seed stratified 3 days or less. Twenty days of stratification, however, was considerably more effective than 8 days. These results with individual lots of slash and loblolly seed indicate possible savings in refrigeration costs and also increased flexibility of seed testing and nursery sowing schedules. They also illustrate the differences to be expected between fresh and stored seed and the necessity of fitting stratification to the peculiar needs of each seed lot.

Nursery root rot

Results from the study of the root rot at the Ashe Nursery continue to be encouraging. Fall-sown longleaf was practically free of root rot. Spring-sown slash pine seedlings from beds treated with sawdust at the rate of 30 tons per acre had no dead tap roots. The average number of plantable seedlings produced per square foot was greater for longleaf than for slash (34 vs. 21), and the percentage plantable was higher: 94 percent for longleaf, 75 percent for slash.

Data from the current experiments at the Ashe point up the severe drain of nutrients from southern nursery soils and the great need for adequate soil management. Longleaf demands more soil nutrients than slash because it produces a greater dry weight of seedlings per acre, but even slash demands more than common row crops like corn and cotton. The dry matter removed per year from the Ashe Nursery is estimated to weigh up to 8 tons per acre for longleaf beds and 4 tons for slash pine beds.

Nursery weeding

At the nursery on the Harrison Experimental Forest, allyl alcohol gives promise of effective early weed control, and may increase seedling stands by reducing pre-emergence and damping-off losses. In 1947, 12 man-days were required to weed 250 linear feet of untreated 4-foot bed, as against only 3½ man-days to weed 325 feet of bed treated with allyl alcohol in 1948. The chemical is dangerous to handle and safety instructions should be strictly observed.

Direct seeding

Seeding in Louisiana.--An experiment in direct seeding in central Louisiana showed how site preparation influences initial establishment and survival in the first year. Longleaf and slash pine seeds were sown on areas treated before seeding to produce the following seedbed conditions: (1) disked, (2) plowed furrows, (3) fresh burn, (4) hoed spots, and (5) undisturbed heavy rough. Seeds were sown at a rate of 25,000 per acre on December 1, 1947, and the area patrolled against birds for 45 days. The tree percents (trees established per 100 seeds sown) of the different treatments are shown in table 2.

Table 2.--Tree percents by dates during first season after direct seeding

Treatment	April 23		June 10		July 27		September 9	
	Slash	Longleaf	Slash	Longleaf	Slash	Longleaf	Slash	Longleaf
Disked	29.4	16.4	28.0	15.6	20.1	14.5	6.5	10.6
Plowed furrows	8.7	4.8	8.6	4.8	8.0	4.5	7.0	4.1
Fresh burn	33.2	11.2	32.5	10.9	15.4	7.0	.6	1.1
Hoed spots	7.4	2.4	7.1	2.2	3.8	1.4	.2	.4
Untreated rough	0	0	0	0	0	0	0	0

Despite a severe summer drought that caused widespread plantation failures in this territory, there was a satisfactory stand at the end of the first year on both the disked and furrowed plots. On the disked area, initial establishment was good and, although some loss occurred during the summer, a satisfactory stand developed. In the furrows, initial establishment was low because heavy rains washed away much of the seed, but most of the seedlings that did start survived the summer drought remarkably well. On the fresh burn, initial establishment was good--comparable to the disked area. Summer mortality, however, was so great that the fresh burn failed to produce a satisfactory stand by fall, when drought losses ceased. On hoed spots, initial establishment was low because rodents (mainly harvest mice) ate most of the seed. This damage plus heavy drought losses resulted in practically a total failure for hoed spots. The untreated rough, where the grass cover was so dense that practically no bare soil could be seen, was also a total failure.

Rodent damage was negligible on areas where the grass or ground cover was severely disturbed by burning, disking, or plowing. Such site preparation apparently provided effective rodent control.

The results show that slash pine produced a higher initial tree percent than longleaf, and also indicate that longleaf resisted drought better than slash.

A supplementary seeding, designed to test season of sowing plus various treatments on hoed spots, was made in another area unpatrolled against birds. It was found that although some of the treatments gave good initial establishment, survival was so poor that no satisfactory stands were obtained. The treatments included fall (December 1), winter (February 1), and spring (April 1) seeding, plus hoed spot treatments consisting of screening, mulching, and treating the seed with various repellents. The repellents proved unsatisfactory against birds and apparently also reduced germination. Screening (a mechanical barrier against birds and rodents) of course favored good initial establishment. The results of mulching were variable and less satisfactory. The seasonal test indicated that seeding in late winter or early spring was best for slash pine, while longleaf did best when seeded in the fall.

Plantation establishment

Pine planting.--Underplanting scrub oak with pine at the Alexandria Branch indicated that first-year survival is benefitted by release work done soon after planting. The survivals of loblolly, slash, and longleaf pines were 88, 48, and 48 percent, respectively, on areas released; and 53, 37, and 23 percent on comparable areas not released. Two methods, girdling and Ammate, and two intensities, complete and selective, of release were tested. All treatments apparently were almost equally effective the first year. Complete release treated all hardwoods 0.5 inch d.b.h. and larger, and selective release treated only hardwoods over 3.0 inches d.b.h.

In this study, pines planted under the crowns of hardwoods survived better in the first year than those planted in the openings between hardwood crowns. For example, on the areas not released the survival for loblolly, slash, and longleaf trees that were located under hardwood crowns was 62, 52, and 38 percent, respectively, as compared to 44, 27, and 16 percent for trees situated in openings between hardwood crowns. This apparent relationship of early survival and hardwood cover has an important bearing on planting practices, for frequently it has been the practice to refrain from planting pine under the crowns of any hardwoods. Further investigation of this relationship is needed before safe conclusion regarding it can be drawn. It may well be that the severe summer drought prevailing during the study influenced the results.

Machine planting.--In a comparative test in north central Louisiana, June survivals of (Lowther) machine-planted slash and longleaf pines were 68 and 86 percent; the corresponding survivals of hand-(bar) planted checks of the same species were 52 and 89 percent. These results indicate that under normal conditions machine planting gives as good survival as hand planting. This conclusion is not weakened by the subsequent failure of the test plantings during the abnormal summer drought of 1948, for most other plantations on the area also failed to survive the drought.

First- and second-year survivals of machine-planted longleaf pine in south Mississippi continue to be almost as good as for bar-planted seedlings.

Underplanting

In February 1948, underplantings of loblolly pine at 6- by 7-foot spacing were made in some poor hardwood stands on the Flat Top Experimental Forest near Birmingham, Alabama. The trees were given two degrees of release by means of improvement cuttings which removed undesirable stems in the overstory.

The treatments were: (1) commercial-type improvement cutting made immediately after planting, removing only those undesirable stems that were merchantable; (2) intensive release cutting which removed all undesirable trees 1.6 inches d.b.h. or over. Additional plots were reserved for release cutting to be delayed until after the first growing season. The first part of table 3 summarizes the results observed for loblolly pine at the end of the first growing season.

Table 3.--Effects of early release of loblolly pine and yellow-poplar planted under hardwoods

Treatment	Survival	Average total height	1948 average height growth
	Percent	Feet	Feet
		Loblolly pine	
Intensive release	77.5	0.98	0.51
Commercial cutting	66.7	.86	.38
Untreated check plots	78.0	.65	.35
		Yellow-poplar	
Intensive release	85.2	1.13	0.82
Commercial cutting	88.9	.91	.57
Untreated check plots	93.9	.76	.38

Yellow-poplar was planted in a study similar to that of the loblolly pine underplanting (table 3). Both treatments and the check resulted in good survival, though more planted trees were killed by skidding operations, and logging slash was somewhat deeper, on the intensively cut plots. Both total height and 1948 height growth increased with the intensity of release.

Hybrid pine plantings

The California Forest and Range Experiment Station has crossed F_1 generation shortleaf-loblolly hybrids with loblolly, shortleaf, and each other. During 1948, the Southern Station grew F_2 seedlings from seed resulting from these crosses, and will plant them at several locations in Arkansas, Alabama, and Mississippi. Survival and growth of the hybrids will be compared with that of locally produced parent species.

Baldcypress planting

The first-year results of a cooperative study with the Joseph Rathborne Land Company, Harvey, Louisiana, show promising survival and growth of baldcypress seedlings planted in a typical cypress-tupelo swamp. Since nursery stock was not available, 1- and 2-year-old wildings were collected. Fifty seedlings were measured and planted in 14 inches of water in January 1948, with their tops 1 to 49 inches out of the water. The water level was then recorded at weekly intervals. The water reached a maximum depth of 24 inches in early March. On the whole, the fluctuations in water level were typical of the site and of thousands of acres of cypress-tupelo swamp in southern Louisiana.

Reexamination in November 1948 showed 67 percent survival of 1-year-olds that had been submerged less than 20 days during the beginning of the growing season and whose tops were six or more inches out of water when planted. These seedlings averaged 30 inches long (plantable tap root plus top). Survival was 55 percent for 1-year-olds submerged 20 to 29 days, and 31 percent for 1-year-olds submerged 30 to 45 days. Average height growth in 1948 was 13 inches for all surviving 1-year-olds and varied very little with different durations of submergence. None of the 2-year-old seedlings were ever submerged; all survived and average 1948 height growth was 10 inches. All of the planting was done under about a 50 percent crown canopy of small pole-size to small sawlog-size trees (mostly of no present or prospective merchantable value). Evidently baldcypress can be successfully planted under these conditions by using 1-year-old stock at least 29 inches long (plantable root plus top), a size that can easily be obtained in a nursery. These early results are so promising that the company collected baldcypress seed in the fall and will sow it in a nursery in the spring of 1949.

Cottonwood planting

The search for more efficient methods of controlling vegetation that competes with cottonwood cuttings during the first growing season has continued without notable success. The best methods found previously involve the use of a Mathis four-disc plow for site preparation, application of fertilizer to individual trees in the spring, and a hoe release in the early summer. These methods were successfully repeated, but cheaper methods that were tested did not give satisfactory results.

Many chemicals and varying intensities of application were tested in the hopes of controlling annual weeds at low cost. None of them produced the desired results: 400 trees per acre reaching a height of 36 inches by the end of the first growing season when planted at the rate of 726 cuttings per acre. The 1948 growing season, however, was relatively dry--there were only 10.7 inches of rain from April through July. 1947 rainfall for the same 4 months was 20.5 inches.

Dow Selective No. 27 came the nearest of the chemical weed killers to reaching the desired norm. It was applied at the rate of

$2\frac{1}{2}$ gallons per acre to the surface of the ground one week before planting. The cuttings were fertilized after planting and released by hoeing in mid-August. Only 34 percent of these cuttings reached a height of 36 inches.

Dow Selective No. 27, allyl alcohol, Isco AA, and the sodium salt of 2,4-D were all reasonably effective in controlling weeds for the first 6 or 8 weeks after application. Additional treatment appears necessary for longer control. The chemicals also seemed to have a deleterious effect on vigor. Most of the trees were not so stocky or tall as those in untreated areas. Mineral spirits did not give effective control of weeds several inches tall, and protecting the trees from this material during application increased the cost. Calcium cyanamide was a failure. It stimulated the growth of weeds. A side study on the use of paraffin and of activated carbon to protect the cuttings against 2,4-D showed them both to be ineffective.

The application of fertilizer, while increasing the height growth and vigor of individual trees and the percentage of trees reaching 36 inches in height, decreases over-all survival. This reduction in survival appears to be due to the "burning" effect of fertilizer during dry weather. Further work is necessary on the amount and method of application. One of the needs for fertilizer has been to stimulate height growth of cuttings planted late in the season to avoid submergence by flood waters. But, average height of late-planted cuttings on swamp sites has shown little increase from the use of fertilizer. Unless second-season improvement is obtained, there will be little to gain in continuing a study of this phase.

Refrigerated cuttings retain their viability and establish themselves in swamp sites when planted in late May. With favorable weather conditions, even July plantings survive. The principal difficulty is the shortness of the growing season left for the cuttings to attain height enough to insure second-season success against competition from weeds.

Nursery yields of cottonwood cuttings increased over last year, and the spacing of 40 inches by 12 inches produced at the rate of 16,000 cuttings per acre. This is still less than anticipated production, though due in part to an unfavorable prior soil treatment and the dry season. Mortality, averaging 15 percent of the living trees at the end of the first year, gave increased room for growth and consequent undesirable extra vigor, since the main stems became too large to use economically for cuttings.

Tests indicate that plantation spacings of 6 by 6 feet and 4 by 10 feet are too close for cottonwood. They result in early competition that reduces the growth of even the larger trees. Increasing the spacing up to 10 by 10 feet has in every case increased both height and diameter, and indicates that even wider spacings should be tried. Height growth for the first 6 or 7 years is about the same for all spacings within a given site, although there is a noticeable difference between sites. The moister sites produce the greater heights and the larger diameters. Considerable mortality has occurred on the swamp sites. Here a high water table causes the trees to develop shallow root systems and thus makes them readily subject to wind-throw and to tipping when they are loaded with ice.

Further tests in old-field areas in the "buckshot" (Sharkey clay) soil type which have been in cultivation several years continue to show their unsuitability for cottonwood. Soil specialists think that the use for farm crops has removed much, if not all, of the organic matter from the soil and reduced its ability to hold moisture. Successful planting of these sites may depend on restoring organic matter to the soil.

Results to date in a cottonwood plantation originally interplanted with corn and cultivated one year clearly illustrate the effect of differences in site. This plantation is partly on a "buckshot" ridge, partly on a short slope between the ridge and a shallow slough or swamp. The ridge portion in 6 years produced trees averaging 22 feet in height and 2.6 inches d.b.h. The slope portion, with a much greater amount of moisture, produced trees averaging 31 feet in height and 4.1 inches d.b.h. The larger trees are already shedding their lower limbs. The maximum sizes produced in 6 years are: slope, 50 feet and 8.8 inches d.b.h.; ridge, 42 feet and 5.9 inches d.b.h.

Cottonwood plantings at the Alexandria and Tallahatchie Branches show survivals ranging from satisfactory to good. Height growth, however, has been below the Mississippi River Delta average, and very few trees have attained 36 inches by the end of the first growing season. This may not be too important if second-year and later survival and growth indicate the trees are able to withstand competing vegetation, which probably will not grow as fast as in the Delta. Again, fertilization and release by hoeing have shown the best first-year results.

Spoil-bank plantings

In Alabama, saw-tooth spoil banks created by strip-mining for coal were planted with shortleaf, longleaf, and loblolly, and direct-seeded with the same three species plus slash pine. The spoil banks, of partially decomposed gray shale, were relatively new, having been deposited only 1½ years before the planting took place in March 1946. In 1948, the spoil banks appeared to be fairly well stabilized.

A 100 percent inventory of the plantations at the end of the third (1948) growing season gave the results shown in table 4.

Although the survival and growth of shortleaf pine were satisfactory, the prevalence of littleleaf disease in north central Alabama should discourage any extensive planting of shortleaf. The slow initial height growth of longleaf pine in combination with the instability of new spoil banks placed this species at a definite disadvantage on such sites. Observations on older spoil banks not too heavily overgrown with weeds and brush show that longleaf may do much better there than it did in this test.

Table 4.--Pine development 3 years after planting on Alabama spoil banks

Species	Survival	Av. total height	Av. height growth for 1948
	Percent	Feet	Feet
Loblolly pine	86	3.3	1.0
Shortleaf pine	69	2.3	.6
Longleaf pine	22	.4	.3

Direct seeding proved to be almost a complete failure, either because of soil and rock movement, season of sowing (March), rodent injury, or a combination of these factors. A few seedlings could be found, but there was no way of determining whether they came in from the seeding or from natural sources. In either case, there was insufficient reproduction for a satisfactory stand.

In another study, fertilized white ash and loblolly pine showed somewhat better total height growth than unfertilized, but heavy washing of soil on spoil banks could very well remove this benefit within a few years after planting. Effects of fertilization on survival were inconclusive.

In a test of the growth of various hardwood species along the margins of permanent ponds created by strip mining, sycamore has far outgrown other species. Water tupelo and green ash made satisfactory survival and growth. White ash survived somewhat better in this damp site than on hillsides, but its growth was better on the hillsides away from the water.

Judging by the results of 3 years' growth, loblolly pine seems to be the most satisfactory species for planting on newly formed spoil banks, and sycamore the best species for margins of ponds.

Influence of spacing on yield in loblolly pine plantations

At the Alexandria Branch, a thinning study was started in 20-year-old loblolly pine plantations. This study, made in cooperation with the Louisiana Forestry Commission, shows the effect of various initial spacings on early yield. The trees were planted at four different spacings: 4 by 4, 6 by 6, 8 by 8, 10 by 10 feet. The 8 by 8 spacing produced the greatest total pulpwood volume in 20 years (31 cords per acre), and gave the highest net profit from thinnings alone. The thinning paid $12.64 per acre above all costs of establishing and carrying the plantation, and left a stand of over 20 cords.

The 4 by 4 spacing produced a little more than 27 cords in 20 years. Even here the thinnings almost paid all costs and left a stand of more than 16 cords per acre. At this spacing, however, the trees showed signs of stagnation and should have been thinned earlier, though the trees removed would have been too small for anything but fence posts.

On the basis of this study, either the 8 by 8 or the 6 by 6 spacing would be generally recommended for planting loblolly pine in central Louisiana. The former, because of its lower cost of planting and higher production of pulpwood volume, is ahead at 20 years of age, but the higher quality of sawlogs expected from the 6 by 6 may cause the net profit from this spacing to forge ahead in the future. Spacing also influenced costs of cutting the wood. In the 4 by 4 and 10 by 10 spacings, only 2.6 cords of wood were produced per man-day. In the 6 by 6 and 8 by 8 spacings, approximately 3 cords per man-day were produced.

Forest establishment on abandoned lands

As a preliminary study, growth and development of ten loblolly and ten shortleaf pine plantations set out in north Mississippi in 1936 were measured to determine the average size and production of each species.

Indications are that: (1) At 12 years, loblolly plantations produce over twice as much merchantable volume as shortleaf; 1.1 cords per acre per year for loblolly against 0.5 cord for shortleaf. (2) Severe and continuous attacks by the pine tip moth seriously impair the growth of shortleaf. (3) Loblolly is more susceptible to damage by sleet and ice storms than shortleaf, but this disadvantage is outweighed by its much faster growth.

Silviculture

Improvement of depleted stands

Pine-hardwoods.--At the Birmingham Branch, a study involving three different treatments of depleted pine-hardwood stands was installed in late 1947. The first treatment was a commercial cut that removed all undesirable trees which were merchantable in the sense that each tree removed would at least pay the cost of harvesting. Under this treatment, 42 percent of the total basal area was cut at a net profit of $3.40 per acre. The second treatment removed all low-quality trees 5.6 inches d.b.h. and over, whether merchantable or not. By this method, 48 percent of the total basal area was cut at a net profit of $1.32 per acre. The third and most intensive cutting removed all undesirable trees over 1.5 inches d.b.h., and trees less than 1.5 inches d.b.h. if they were directly overtopping desirable reproduction. This treatment removed 79 percent of the total basal area and was made at a net cost of $0.99 per acre. The most intensive treatment will undoubtedly produce the greatest benefits, but the additional cost of such an operation may not be offset by increased returns within a reasonable period.

Table 5.--Initial costs and returns of treating depleted pine-hardwood stands

Undesirable trees removed	Cutting and hauling	Labor cost	Total cost	Gross return	Net return
	Man-hrs.	- - -	- Dollars	- - -	
Merchantable	38.3	28.72	43.01	46.41	3.40
Over 5.5 inches d.b.h.	39.4	29.55	44.29	45.61	1.32
Over 1.5 inches d.b.h. and smaller ones overtopping desirable reproduction	53.2	39.90	58.60	57.61	-.99

Bottomland hardwoods.--The Delta Branch established two plots of a series planned to study the management of depleted stands of bottomland hardwoods. One plot is representative of many lightly depleted stands in the Delta. The stand per acre 6 inches d.b.h. and larger includes 31 trees, containing 36 square feet of basal area, and 2,595 board feet (Doyle rule) of growing stock, or trees of desirable form, quality, and vigor. All of these trees have been left for further growth.

The stand also had an overburden of 39 trees per acre. Of these, 14 were sound and rotten culls totaling 9 square feet of basal area. The other 25 were trees of undesirable form, quality, and vigor; they contained 22 square feet of basal area and 1,096 board feet of sawlog material. The overburden saw timber was cut and sold at a price equivalent to $10.96 per acre for stumpage. The overburden below sawlog size, the culls, and the tops of sawlog trees will be cut for firewood.

It is estimated that the growing stock will attain a basal area of at least 45 square feet per acre in 10 years. A second improvement cutting to remove commercial saw timber probably can be made 15 years from now, and in 25 to 30 years the stand should be well stocked with desirable trees of all sizes up to and including large saw timber.

The second plot is representative of many moderately depleted stands in the Delta. There are 23 trees per acre 6 inches d.b.h. and larger containing 18 square feet of basal area, and 902 board feet (Doyle) of growing stock. The undesirable part of the stand, or overburden, was cut and sold. It contained 12 merchantable and potentially merchantable trees, aggregating 13 square feet of basal area, and 847 board feet of saw-timber-size material plus 15 culls totaling 9 square feet of basal area. The remaining overburden below sawlog size and the culls will be cut for firewood. There is good reproduction in the openings, and 234 trees per acre of growing stock quality in the 1- through 5-inch d.b.h. classes. Eventually this stand should become as productive and well stocked as the one first discussed, but it will take much longer since there is only about half as much growing stock.

In contrast to these two plots in depleted stands, a plot was established in an adjacent well-stocked stand to determine growth and yield under management. In trees 6 inches d.b.h. and larger, this stand contains 43 trees, 56 square feet of basal area, and 4,361 board feet (Doyle) per acre of growing stock. In addition, there are 27 trees, 24 square feet of basal area, and 1,588 board feet per acre of overburden or undesirable trees, plus 51 cull trees containing 11 square feet of basal area. In an improvement cutting, 1,104 board feet per acre of overburden were removed and sold. In addition, 2 cords of firewood per acre were cut from the tops of sawlog trees, culls, and undersawlog-size overburden trees of low vigor. Information obtained on growth and management of this well-stocked stand, one of a series that will be intensively studied, will be applicable to currently depleted stands after they have been built up to good stocking.

It was found that the ability and experience of the woods crews largely determine whether or not logging to improve these depleted stands can be done at a profit. A logging contractor would thus do well to hire experienced men even if a higher wage rate is required. Felling and skidding must be done carefully if damage to the growing stock and reproduction is to be avoided. Extra time is often needed for jump-butting. To get the most out of these crooked, limby, and defective trees, it is best to select the bucking points while the tree is still standing and all parts of the trunk are visible. The high percentage of short logs from such trees makes loading difficult.

Management of commercial stands

Longleaf pine.--At the Gulfcoast Branch, three methods of managing longleaf pine are being studied--intensive treatment with thinnings every 3 years, moderately intensive treatment with thinnings every 5 years, and extensive treatment with thinnings every 8 years. Eighteen 40-acre compartments are included in this study. Thus far, the first cut has been completed on eight compartments, and on seven more compartments it is complete except for the pulpwood cut. Hundred-percent inventories showed an average pine volume of about 5,600 board feet, International ¼-inch rule, per acre before cutting, of which 28 percent was old-growth longleaf, the remainder second-growth. Thus far, about 22 to 24 percent of the total board-foot volume on each compartment has been cut. Returns from sawlogs, mostly from old-growth longleaf which were unmerchantable when the virgin forest was logged in 1902, account for 65 percent of the total. Pine and hardwood pulpwood and pine poles and posts also are being cut.

At the Brewton Branch, a study of longleaf pine management systems and rotations has been started. Cutting is practically completed on the first of six 40-acre compartments in a 24-compartment study of seed-tree and group-selection management systems and 40-, 60-, and 80-year rotations.

Shortleaf-loblolly pine-hardwoods.--In 1937, a study of four methods of cutting was installed in the shortleaf-loblolly pine-hardwood type on the Crossett Experimental Forest. The methods were: (a) selection, (b) shelterwood, (c) clear-cut for sawlogs, and (d) clear-cut for all commercial material larger than 6 inches d.b.h. This study was duplicated in 1942 on a second series of plots. The two series of plots were reinventoried in December 1947, and the selection plots in both series and the plots clear-cut for sawlogs in the first series were cut a second time in early 1948. Annual board-foot growth per acre for the 5-year period 1942 to 1947 is presented in table 6.

Although the second series was established primarily in natural second-growth stands while many plots of the first series were in old-field stands, growth has been very similar. One outstanding feature has been the rapid development of the stands which were clear-cut for sawlogs in 1937. The second clear-cutting for sawlogs of these plots yielded 3,115 board feet per acre.

Table 6.--Annual growth per acre under various methods of cutting, Crossett Experimental Forest

Method of cutting	Annual growth	
	1937 series	1942 series
	Bd. ft. (Int. ¼" rule)	
Selection	437	414
Shelterwood	150	193
Clear-cut for sawlogs	354	216
Clear-cut all commercial material	...	...

As the plots in both series were too small to allow valid conclusions, a similar study was established on a much larger scale. The new study occupies thirty-three 40-acre compartments. It will test three management systems and two rotations. In 1948, harvest cuts were made on six compartments. Two were cut selectively (flexible but largely individual-tree selection), two by the group-selection system, and two by the seed-tree method. One compartment of each treatment was logged by an independent logging contractor, and one of each was logged by Forest Service crews and equipment. The figures are subject to modification as additional compartments are logged. However, a comparison (table 7) of the volume removed, average log size, and logging cost per thousand board for each of the three methods is of interest, since these items will have to be considered along with yield and other factors in ultimately deciding which system is best.

Allowance for unfavorable weather while logging compartment 8 will probably reduce the cost of group-selection logging by $1.00 per

Table 7.--Volume cut and costs by different harvest-cutting methods in the shortleaf-loblolly pine-hardwood type, Crossett Experimental Forest

Logged by	Compt. no.	Total logged	Cut per acre	Average log size	Logging cost per M
		Bd.ft.	Bd.ft.	Bd.ft.	Dollars
			Seed-tree		
Contractor	98	181,529	4,631	71	9.33
Forest Service	9	268,894	7,794	74	9.55
Average			6,112	73	9.46
			Group-selection		
Contractor	97	51,505	1,324	72	10.29
Forest Service	8	75,328	1,828	74	11.48
Average			1,583	73	11.00
			Selection		
Contractor	100	70,629	1,873	102	9.18
Forest Service	10	100,762	2,482	89	8.80
Average			2,189	94	8.96

thousand, but will still leave it the most costly of the three treatments. The seed-tree method is often assumed to be the cheapest of the three logging methods because of the greater volume produced, but it is somewhat more costly than selection cutting. Under the latter system, only about one-third as much volume was produced as from the seed-tree areas. The logs produced under the seed-tree and group-selection cutting treatments averaged considerably smaller than under the selection cutting.

In east Texas, a method-of-cutting study was established in 1938 in a well-stocked, 45-year-old loblolly and shortleaf pine stand on the San Jacinto Experimental Forest. In 1948, the plots were remeasured and further cuttings made. Conclusive results cannot be obtained from the first 10-year period in a long-range study, but the following observations summarize progress to date:

1. Average annual net growth per acre in 10 years on good sites has been highest in plots heavily thinned for pulpwood to maintain an even-aged stand--77 cubic feet, inside bark, in trees 4 inches and larger, and 518 board feet (International $\frac{1}{4}$-inch rule) in trees 10 inches and larger. This production was followed closely by plots cut selectively for saw timber in 15- and 10-year cycles. The differences among these three methods are not statistically significant.

2. Average annual net growth percent in cubic feet has been highest, 18.4 percent, in plots cut to a 7-inch d.b.h. limit for pulpwood. This is a natural result of leaving the least growing stock. Annual growth percent in board feet has been highest (9.3 percent) in the plots heavily thinned for pulpwood. In both cases, the plots are on good sites. Of the saw-timber cuttings on good sites, 15-year selection and shelterwood methods rate best, with 6.8 and 6.7 percent, respectively.

3. Net growth per acre in both cubic feet and board feet increased during the second 5-year period with all methods except shelterwood, which showed a decrease in net board-foot growth, and the 5-year saw-timber selection method, which showed a decrease in growth both in cubic feet and board feet.

4. Recent abnormally high mortality, primarily from ice and beetles, has been nearly three times as severe in shortleaf as in loblolly.

5. On good sites, reproduction is generally satisfactory on the heavily cut areas where it is most needed. A shelterwood cutting on a poor site has not yet fully reseeded.

6. In the selection cuttings, it is too early to tell whether the reproduction is adequate. Some openings seem to be restocking satisfactorily with pine, others are apparently being taken over by brush.

7. Shelterwood cuttings on good sites look very good. Volume growth is only fair in amount but high in percent and quality. Reproduction is vigorous and generally adequate in amount and distribution.

8. The clear-cut plots have such excellent reproduction--especially from the standpoint of size and growth rate--that clear-cutting in strips about 2 to 4 chains wide may be a good method where the stand to be cut is composed largely of trees that are financially mature.

9. The 10- and 15-year saw-timber selection cuttings have resulted in very good growth, both in volume and quality, but adequacy of the reproduction is questionable. The 5-year selection cuttings so far seem to be too light either to benefit the growth rate markedly or to permit adequate reproduction.

As these results were obtained on small plots, the more promising treatments with some modifications are now to be tested on a pilot-plant basis on the Stephen F. Austin Experimental Forest. Thirty-six 10-acre plots, each with a 5-acre isolation strip, have been established, inventoried, and marked for a study of four silvicultural systems. A total of 800,000 board feet of pine will be cut in tests of individual-tree selection, seed-tree cutting, shelterwood, and clear-cutting on narrow strips.

Bottomland hardwoods.--An inventory of the 2,580-acre Delta Experimental Forest in the bottomland hardwood type at Stoneville, Mississippi, in September 1936 showed a net volume of 2,473 M board feet, Doyle rule. Between 1936 and 1948, 1,548 M board feet were cut in commercial improvement cuttings, but an inventory in March 1948 showed a net volume of 4,580 M board feet. Even though the stand still needs considerable treatment to put it in good condition, growth has been at a rate of 8 percent compound interest annually during the last 11 years. Much of this growth is, of course, accounted for by 8- and 10-inch trees that have grown to sawlog size since 1936.

A particular point of interest concerning the development on this experimental forest since 1936 is the transformation of a 70-acre area of apparently worthless brush into a well-stocked young sapling and pole stand. This area was described in 1936 as an abandoned field that had last been cultivated in about 1926 and was "so completely covered with brush and briars that no reproduction is present." This observation was made by a cruiser who was not intimately familiar with bottomland hardwoods. His conclusion is not an uncommon one in the Delta: potentially satisfactory stands of reproduction are frequently mistaken for worthless brush. Evidently this particular area had a good stocking of reproduction up to about 1 inch d.b.h. in 1936, for it is now well-stocked with trees of desirable form, quality, and vigor. There are 380 trees per acre 2 to 4 inches in d.b.h., and 30 which are 6 to 10 inches in d.b.h. Trees of undesirable form, quality, and vigor (overburden) total 760 per acre 2 to 4 inches d.b.h., and 25 per acre 6 to 10 inches d.b.h.

Estimates of growth after a projected improvement cutting were made for a Delta landowner who is interested in the possibilities of forest management. His forest, of nearly 3,000 acres, is a typical Delta saw-timber stand. In one portion of the stand, in the sweetgum-water oak type, the improvement cut will take out about 1,900 board feet per acre from a total of 5,500 board feet. It is estimated that in 10 years the remaining trees will have grown to 5,600 board feet. This is a growth rate of 5½ percent, or 200 board feet per acre yearly. In rather similar stands in the overcup oak-water hickory (bitter pecan) type, twice as much volume will be removed in the improvement cut, and a corresponding decrease in volume growth is expected.

The Delta Branch has also started a study of management of mature cottonwood. The stand under study is about 55 years old. Before it was marked and cut it averaged 19,908 board feet (Doyle rule, gross scale) per acre in cottonwoods 12 to 34 inches d.b.h., plus 577 board feet in sugarberry (hackberry), sycamore, boxelder, and pecan 12 to 18 inches d.b.h. Diameter growth rate of dominant and codominant cottonwoods has been declining steadily for the last 12 years; it was 1.36 inches in the last 5 years, but 1.97 inches between 1933 and 1938. A cutting should have been made when the stand was about 43 years old. If this had been done, it is unlikely that diameter growth of the remaining trees would have decreased.

The cut at 55 years left 9,078 board feet per acre of the thriftiest cottonwood and the entire 577 board feet of other species. This amounted to 38.0 square feet of basal area in cottonwood and 16.5 square feet in other species. The cutting removed 10,830 board feet per acre of mature cottonwood, a total of 44.8 square feet of basal area. Only one more heavy cutting of cottonwood is in sight. If sawlog cutting had started at 43 years of age, three rather than two such profitable cuttings could have been made. Of the remaining stand 12 inches d.b.h. and larger, 96 percent (by basal area) of the cottonwood, but only 14 percent of the other species, is considered good growing stock. A small proportion of this undesirable material will make low-grade sawlogs in the next cut, but utilization of the rest remains a problem. The problem is even more serious when it is considered that of 14.4 square feet per acre of basal area in trees 2 through 11 inches d.b.h., 84 percent is undesirable.

The marking was designed to leave cottonwoods 28 inches d.b.h. and larger only when they were growing at the rate of at least 3 inches d.b.h. in 10 years. This was successfully done. Increment borings in remaining cottonwoods of this size showed an average d.b.h. growth rate of 3.6 inches in the last 10 years. The smaller cottonwoods (22 to 26 inches d.b.h.) that were left had much smaller and less vigorous crowns, and had been growing at a rate of 2.7 inches d.b.h. in the last 10 years.

Factors influencing growth of oak in the Arkansas Ozarks

In cooperation with the University of Arkansas, the Ozark Branch completed a study that shows the effect of site conditions on volume growth during a 10-year period in well-stocked but unmanaged oak stands found in the region. Results will soon be published as Arkansas Agricultural Experiment Station Bulletin 484.

Oak stands 50 to 120 years old were studied in relation to commercial value, composition, occurrence, growth, and general site conditions. They were classified into the following forest types:

1. Commercial: white oak type and white-black-red oak type.

2. Intermediate: black oak-hickory type.

3. Noncommercial: blackjack-post oak type.

The volume, basal area, and number per acre of trees 1.6 inches d.b.h. and larger is shown for each type in table 8.

Annual periodic volume growth during the past 10 years varied by site index class (average height of dominant and codominant trees at 50 years) as shown in table 9.

Table 8.--Stocking and volume per acre in the oak types of the Arkansas Ozarks

Type	Stands studied	Trees	Basal area	Average age	Gross volume[1]
	No.	No.	Sq.ft.	Years	Cu.ft.
White oak	25	245	106	67	2,386
White-black-red oak	22	271	94	58	2,265
Black oak-hickory	18	182	86	70	2,000
Blackjack-post oak	21	252	76	77	1,116

[1] Entire stems, less bark.

Table 9.--Annual periodic volume growth for the past 10 years in the oak types of the Arkansas Ozarks

Type	Site index			All sites
	60+	50-55	45-	
	Cu. ft., i.b., per acre			
White oak	78	60	48	66
White-black-red oak	81	...	...	...
Black oak-hickory	57	46	27	43
Blackjack-post oak	...	...	23	...

The average annual periodic volume growth during the past 10 years of all oak stands on sites with deep residual soils (excluding alluvial, colluvial, and soils less than 24 inches in depth) was highest on limestone soils and lowest on shale soils. Stands on sandstone soils were intermediate.

Soils derived from:--	Annual periodic volume growth per acre
	Cu. ft.
Limestone	63
Sandstone and calcareous sandstone	46
Shale, shale-limestone, and calcareous shale	32

The oak types classified as having commercial value were all found on soils deeper than 24 inches. Oak types having intermediate and noncommercial values were generally found on sites where the soils averaged 24 inches or less in depth. Annual periodic volume growth for the black oak-hickory type averaged 56 cubic feet per acre on the deep soil sites, and 23 cubic feet per acre where the soil was classed as shallow.

Tree reproduction (1.5 inches d.b.h. and smaller) in each oak type was similar in density but varied considerably in species composition. White oak reproduction varied from about 400 trees per acre in the commercial oak types to less than 100 trees per acre in the blackjack-post oak type. Black oak and hickory were found consistently in all types.

Eastern redcedar

In the Arkansas Ozarks, considerable data pertinent to the management of eastern redcedar were obtained. First of all, a site classification was made. The sites recognized are:

Site I. Alluvial soils, deep and well drained. Site index 50+.
Site II. Upland soils, 24 inches and more in depth. Site index 40-50.
Site III. Upland soils, 12 to 24 inches deep. Site index 30-40.
Site IV. Upland soils, less than 12 inches in depth. Site index 30 or less.

Tests for pH revealed that the soil is less acid under natural stands of redcedar than in adjacent openings. The pH of the soil under a 44-year-old plantation which had been arbitrarily established in one corner of an old field was 7.0 and 6.2 at soil depths of 2 to 3 and 3 to 6 inches. Outside the plantation, the pH was 5.4 and 5.0 at the same soil depths. This increase in pH under redcedar is undoubtedly due to high calcium content of the foliage. Calcium contents of the foliage of several sample redcedar trees on various sites were:

	CaO
Sapling-size tree on site III	1.88%
Post-size tree on site III	2.14%
Sapling-size tree on site II	2.22%
Post-size tree on site II	2.58%.

From these and other data, it was concluded that the present natural stands of redcedar in the Ozarks are more commonly found on shallow soils and rough topography, not because these are preferred habitats, but rather: (a) because of its resistance to drought, eastern redcedar is usually the only forest species that can grow to a usable size on such adverse sites; (b) because of its susceptibility to fire, redcedar survives only where protected from repeated burning by the natural barriers and small amounts of forest fuels which characterize rough, rocky terrain.

Because redcedar logs are sawed into boards of narrow width and short length (minimums of 2 inches and 2 feet, respectively), no standard log rule scales their contents satisfactorily. By revising the formula for the International $\frac{1}{4}$-inch rule, however, an equation was developed by which the sawed contents of small redcedar logs can be closely estimated. The revised equation assumes a slab-edging collar depth of 0.45 inch instead of about 0.8 inch, and allows for saving one saw line and eliminating shim loss.

The revised equations for the new rule for redcedar logs are:

$$\begin{aligned} V &= 0.20D^2 - .36D + .33 \text{ for a 4-foot section;} \\ & 0.40D^2 - .52D + .53 \text{ for an 8-foot section;} \\ & 0.60D^2 - .48D + .70 \text{ for a 12-foot section.} \end{aligned}$$

Natural regeneration

Longleaf pine.--Seed studies have shown that (1) second-growth longleaf pines are good cone producers, (2) seed from second-growth trees is not inferior to that from old growth, and (3) the cones are larger and seed yield per cone is greater from smaller trees. There appears to be a consistent, wide variation in quality of seed from individual trees, though the cause has yet to be determined.

Shortleaf-loblolly pine.--On the Crossett Experimental Forest, an area which has been logged annually under the selection system and from which fire has been excluded for 15 years was studied to determine whether or not normal litter accumulation was a barrier to establishment of seedlings.

In August 1948, the area had 10,300 seedlings per acre from the bumper seed crop of the previous year. This is considered to be in excess of the needs for adequate restocking, even after allowing for heavy mortality. Litter depth averaged 1.3 inches, and observation indicates that this is the approximate average on long-unburned stands of this type in this locality. There appears to be no need for special seedbed preparation to obtain satisfactory initial establishment from bumper seed crops in shortleaf-loblolly pine-hardwood forests similar to those found in south Arkansas when the stands are managed under the individual-tree selection system and protected from fire.

Chemical control of undesirable hardwoods

Upland hardwoods.--Timberland owners in northwest Louisiana have used Ammate solution in single frills at convenient chopping height to poison undesirable hardwoods on more than 3,500 acres of loblolly pine-hardwood forest. Inspection of this work by the Alexandria Branch showed the following advantages of the method:

1. It results in quicker crown kill with less sprouting and requires less labor than a double-hack girdle without Ammate.

2. The total cost is no greater than double-hack girdling.

3. Less chemical is used and total cost is less than for Ammate crystals applied in cups or notches, though there is usually more sprouting from the roots of frilled trees.

4. Many experienced woodsmen prefer to make frills, and it is easier for inexperienced axmen to make frills than cups.

The cost per acre varies with number and size of trees treated, amount of Ammate used, and the efficiency of labor. The average cost per acre for the operations cited has been 30 cents for chemical and $2.10 for labor, overhead, and other costs. From 20 to 60 hardwood trees 6 to 24 inches d.b.h. or larger were treated per acre. Forty trees 10 to 12 inches in diameter can be treated with one gallon of solution. When Ammate is purchased in bulk at 14 cents per pound, the cost of 32.4 percent solution (4 pounds per gallon of water) is 45 cents per gallon. The Ammate solution is clear, but if a red dye is mixed in, treated trees can be distinguished from untreated ones.

At the Crossett Branch, a pilot-plant study of poisoning low-grade hardwoods with Ammate was installed in the fall of 1947. Four methods of application were used. Results determined in the fall of 1948 are presented in table 10.

Table 10.--Effect of Ammate during first year after application to upland hardwoods 3.5 inches d.b.h. and larger

Treatment	Trees with crown dead or heavily damaged	Trees sprouting at or near the ground	Total[1] cost per acre	Ammate used per acre
	Percent	Percent	Dollars	Pounds
In notches:				
Crystals at ground level	95	19	4.75	12.4
Crystals at 30 inches	87	34	4.20	12.4
In frills:				
19.3% solution at 30 inches	92	89	3.98	3.1
37.5% solution at 30 inches	96	93	4.68	7.7

[1] 190 trees per acre averaging 5.1 inches d.b.h. Wages 75 cents per hour, overhead 20 cents per hour, Ammate 15 cents per pound.

Final decision as to which is the best method rests mainly on the cost and the ultimate percentage and vigor of sprouting which can be tolerated, since crown kill is uniformly satisfactory and does not vary much. So far, application of Ammate crystals in notches at 30 inches appears to be the most desirable treatment.

The first reexamination of a small study of different methods of eradicating or controlling scrub oaks on longleaf pine land in south Alabama shows the early effectiveness of Ammate:

1. Pulling the trees with a tractor in 1946 cost 2.8 cents per tree, or $9.91 per acre for 354 trees. About 50 percent of the trees sprouted within a year.

2. Cutting with an ax in July 1947 cost 0.5 cent per tree, or $1.28 per acre for 233 trees. By May 1948, 90 percent of the trees had sprouted.

3. Poisoning with Ammate crystals in September 1947 cost 1.2 cents per tree, or $4.62 per acre for 378 trees. By August 1948, 43 percent of the poisoned trees were dead (no sprouts), 54 percent were dying (with only a few leaves and small sprouts), and only 3 percent showed no effect.

So far, the extra cost of the Ammate treatment over cutting is fully justified by the excellent results obtained. The costs of pulling or cutting were largely wasted because of the widespread and vigorous sprouting.

At the Ozark Branch, first-year results of treating freshly cut stumps of upland hardwood saplings with Ammate crystals in early March showed very little sprouting of chinquapin, black oak, white oak, and dogwood. Sassafras and red maple sprouted vigorously and apparently were not affected by Ammate. Second-year observations were made on clumps of 5 to 15 blackgums up to 8 inches in d.b.h. Presumably each clump had sprung from the same stump and the roots were interconnected. Two or three small outside trees in each clump had been cut and the fresh stumps covered with Ammate crystals. Although nearly all trees left in these clumps were defoliated in the first growing season by this partial treatment, most of them put out normal foliage in the second growing season. Some of the treated blackgum stumps put out a few weak sprouts in the first growing season or the early part of the second, but all were dead at the end of the second season.

Bottomland hardwoods.--Reexamination was made of poisoning tests on water hickory (bitter pecan) started in 1946 and 1947. The most effective methods and their results are shown in table 11.

A 61.5 percent sodium arsenite solution is made by adding 3 quarts of water to a mixture of 8 pounds of white arsenic and 2 pounds of caustic soda. Recent poisoning tests on bottomland hardwoods have been confined to water hickory (bitter pecan) because this species is the hardest to kill. Methods reexamined in 1948 that were ineffective on water hickory include a 1 percent solution of Weedone (a commercial 2,4-D preparation) and solutions of sodium arsenite only one-half and one-third the standard 61.5 percent solution.

Table 11.--Most effective methods of poisoning water hickory

(Poison applied in June. Results observed 2 years, 3 months after treatment, unless otherwise noted.)

Tree size	Most effective methods	Results to date
Sprouts up to 18 feet high	Spray with 32.4% Ammate solution.	100% crown kill within 4 months, 16% basal sprouting.
	Apply 61.5% sodium arsenite solution on flat stumps.	33% basal sprouting.
4 to 8 inches d.b.h.	Pour 61.5% sodium arsenite solution in frills.	100% crown kill within 5 months, no basal sprouting.
	Put Ammate crystals in notches spaced 6 inches apart near the ground.	88% crown kill and 22% basal sprouting 1 year, 2 months after treatment.
	Pour 32.4% Ammate solution in frills.	81% crown kill and 25% basal sprouting.
15 to 30 inches d.b.h.	Pour 61.5% sodium arsenite solution in frills.	100% crown kill within 4 months, no basal sprouting.
	Girdle, exposing a 4-inch band of sapwood. No poison.	81% crown kill and no basal sprouting (but only 11% crown kill in the first 13 months).

Mensuration

Mensuration efforts during 1948 were directed primarily at providing service, advice, and training in sampling, experimental design, and analysis.

A simple method of sampling for sample-tree measurement sales was developed for use on national forests. It is expected that use of this method can reduce personnel to one-fourth of what was formerly required for this phase of timber sales.

An adaptation of the prismatoidal formula was devised to simplify checking cubic-foot volume tables.

A new technique was developed for measuring cubic-foot volume of standing trees by measuring heights to progressively smaller diameters. If a suitable "tree meter" can be manufactured to determine diameter of various sections in the standing tree, this technique should lead to more accurate volume determination of standing trees and to simpler computations; it may revolutionize volume table concepts.

A series of lumber quality indices was prepared to facilitate reducing future mill scale studies to a common quality denominator. If indices prove reliable, they may be extended to simplify timber appraisal calculations.

A stand classification study found that tenth- and twentieth-acre plots are almost equally efficient in inventorying second-growth longleaf in south Alabama.

Forest Influences

Erosion control plantings

Further analysis of observations made of erosion control plantings in north central Mississippi and western Tennessee, though not conclusive, indicate the following useful points:

The most successful plantings were pine. Loblolly pine produced the best results, but all pines were generally better than hardwoods for erosion control. Pines are more tolerant of the poor site conditions common to areas needing stabilization.

Site requirements for forest plantation success apparently were: some topsoil in the surface layer, at least 18 inches of soil that is favorable for plant root development, and medium- to light-textured soils with good internal drainage.

Plantings usually failed if they were on shallow soils, or on parent material with but little subsoil. Trees failed to develop fully on soils of less than 18 inches in depth. Those that made some height growth were uprooted by heavy ice storms.

Successful erosion control plantations that averaged nine growing seasons in age produced trees 10 to 30 feet in height, of good vigor, and with 75 to 100 percent survival. In general, these plantations were reproducing and were being invaded by tree species that require relatively high site quality.

Unsuccessful plantings of the same average age were less than 5 feet in height and of poor vigor. They were not reproducing and were being invaded by species that show wide tolerance to site conditions. These plantations were also severely attacked by insects--shortleaf and loblolly pine by tip moth and black locust by borers and leaf miners.

Grass and legume test plantings

As an adjunct to erosion control by tree planting, small test plantings of 50 species of grasses and legumes have been set out in north Mississippi. Seasonal observations were made on the 1947 plantings and the 1948 spring planting.

A few grass species that might be suitable for erosion control planting in north Mississippi and west Tennessee are: Ky-31 fescue (*Festuca elatior arundinacea*), rescuegrass (*Bromus catharticus*), and jaragua (*Hyparrhenia rufa*). Two legumes that may be suitable are: Ladino clover (*Trifolium repens*) and lanceleaf crotalaria (*Crotalaria lanceolata*).

Fire

Longleaf pine

In cooperation with State Foresters, Region 8, and the Southeastern Forest Experiment Station, fire damage appraisal tables were revised for use in the southern States.

A study in the longleaf pine type in southern Mississippi showed that tree percent and survival from natural seeding are higher on areas burned before seedfall in September and October than on those with older roughs. There was practically no difference between the numbers of living 5-month-old seedlings in May 1948 on areas burned on September 18, October 6, and October 27, 1947. With equal seed supply, however, there were only about 23 percent as many seedlings on plots not burned since 1934 as on those freshly burned.

Early summer mortality (May through July) was about the same on each of the areas burned in the fall of 1947. It averaged 13 percent, which was much lighter than the average of 32 percent on the older roughs. Tree percent at the end of July (based on the number of fully formed seed counted on each plot) was 52 percent on the fresh burns. On the basis of seed actually counted, tree percent in July was 23 percent. However, seed was hard to find on the older roughs and, with allowance for seed that could not be seen but was probably there, tree percent was only 9 percent.

A study of the effect of fire on longleaf reproduction in central Louisiana shows:

1. Age of rough at seedfall did not greatly affect the number of 2-month-old seedlings. Fresh burns, 1-year roughs, and older roughs were compared.

2. Only half as many seedlings survived a dry first summer on 2-year or older roughs as on 1-year roughs and fresh burns.

3. The older roughs had more mortality between the first and seventh years than 1-year roughs and fresh burns.

4. One or two prescribed fires between the first and seventh years gave better 7-year stocking than no burning or annual burning.

5. Competing oaks and older pines had small effect on first-year stocking. Severe hardwood or any pine competition materially reduced seventh-year stocking.

A study of the effect of fire on soil properties was made in a longleaf pine stand in Mississippi. The soil is Orangeburg fine sandy loam; soil samples were taken under a ground cover of grass and shrubs. Soils on open grassy areas on plots not burned since October 1935 were not significantly different in important characteristics from soil on plots burned successively in 1940, 1944, and 1947. Although the period is only 13 years, any difference due to periodic burning should be manifest to some degree now.

Small studies in Florida and Mississippi of the effects of fire on the height growth of longleaf pine seedlings have given different results. In both places, tests were made of light and severe periodic winter fires and of no burning. In Florida, both classes of fires retarded height growth. In Mississippi, light periodic winter fires increased height growth whereas severe periodic winter retarded it. Of the fire treatments not tested in both places, light and severe annual winter fires in Florida retarded height growth, while light and severe periodic summer fires in Mississippi increased height growth. There is considerable difference in site quality at the two places, since on unburned plots it took 13 years in Florida to get the height growth obtained in 9 years in Mississippi (7.3 feet, average height of tallest seedling per milacre plot).

Whether the advantage for light periodic burning in Mississippi is due to release from competition or to temporary brown-spot control cannot be determined. In the Florida plots, however, it is clear that no benefits were derived to offset loss in growth caused by defoliation from fire; growth was worst on plots most frequently and most severely defoliated by burning.

Remeasurements of three plots originally used in a study of the effect of annual burning provide information on the development of unmanaged second-growth longleaf pine. The plots are in south Mississippi, and the trees are now about 35 years old. From 1923 to 1933 one of the plots was burned each winter. The others were not burned (except that at least one wildfire swept over each plot after 1933). When observations on tree growth began in 1928, all three plots were well stocked.

Through 35 years of age, the unburned plots have produced about 42 cords of wood per acre. The burned plot has produced 32.

In the past 10 years, annual growth has been nearly 2.5 cords of merchantable wood per acre on the unburned plots, and 1.7 cords on the burned plot. The stumpage value for poles, sawlogs, and pulpwood now aggregates about $116 per acre on the unburned plots and $102 on the burned plot. All plots have a high proportion of smooth, thrifty trees which will provide excellent future income from high-quality poles and sawlogs.

Shortleaf-loblolly pine-hardwood

A cooperative hardwood brush control study was initiated in a "big thicket" area on the Sam Houston ranger district of the Texas National Forests. This is an exploratory study to determine the practicability of brush control with prescribed burning. In addition to supplying some data on the effects of successive seasonal fires on brush, it should prove of value as a basis for planning other studies and will provide a field laboratory where an accurate fire history is available.

The effects of a single, two, and three burns will be tested. Fires will be set in late spring, early summer, and late winter. One block of eight 80-acre plots is devoted to each of the three seasons tested. Each block contains two plots to be burned once, two to be burned twice, two to receive three burns, and two check plots which will be protected from fire.

A study was started in 1923 to determine the effect of annual fires in different seasons on young loblolly stands. The study was established in a fairly dense 5- to 8-year-old loblolly pine stand on an area near Urania, Louisiana, which had not burned since 1913. The first fires in 1924 and 1925 burned in a heavy grass and pine needle rough. Trees on the plot burned in summer were completely destroyed by a headfire in an extremely dry August. The plots burned in fall, winter, and spring were not damaged much by their first fires or by subsequent annual burning, which ended in 1935. A check plot was not burned.

Remeasurements show that loblolly pine stands over 5 years of age can be burned without noticeable damage when weather conditions are carefully selected, but that in dry weather headfires are disastrous. Seven to ten successive annual burns apparently did not reduce the volume growth of young loblolly stands. Annual fires materially reduced fire hazard through reduction of grass and litter, and killed many suppressed seedlings and intermediate saplings.

Pine Sawfly

In 1946, a series of paired trees, defoliated and nondefoliated by the pine sawfly (Neodiprion banksianae), were selected for study of current growth loss resulting from defoliation. The trees include both shortleaf and loblolly pine. In the fall of 1948, measurements were made of the amount of radial growth these trees had made over each of the previous 4 years. Although analysis is not complete, it is apparent that with forest-grown trees a defoliation of 75 percent or more will reduce growth at least 50 percent during the year of defoliation. The study further shows that one defoliation will result in an additional loss of growth during the second year following the attack.

In a stand of pine averaging 5,000 board feet per acre or more and growing 400 board feet per acre per year, the growth loss due to severe defoliation would amount to approximately 200 board feet per acre the first year. With stumpage at $30 per M b.m., this one year's loss of growth would be $6.00 per acre. With further growth loss for perhaps 2 or 3 years before full recovery, one defoliation of a good stand could result in a loss of $10 or more per acre.

Farm Forestry Research

Alabama

Assistance was given to the Alabama Agricultural Experiment Station in preparing a guide to forestry experiments of that Station, completing the cooperative work on experiments that were maintained by the Norris-Doxey project during the war. An article, "Thinning Even-Aged Loblolly and Slash Pine Stands to Specified Densities," was submitted to the Journal of Forestry. This article describes a method used at Auburn in making experimental thinnings. The method is based on the relationship of basal area per acre to average diameter at breast height.

Work was started on a study to determine what farm woodlands in central Alabama can contribute--in wood for sale as well as for farm use--to the entire farm operation.

Mississippi

Final work on an office report of the north Mississippi plantation survey was continued but not finished. Two articles reporting information from this survey were published in Mississippi Farm Research. Hardy catalpa was found to be unsuitable for planting on old-field sites in north Mississippi. The results of a severe ice storm at and near State College, Mississippi, in February 1948 were observed in six 12-year-old loblolly, shortleaf, and slash pine plantations. Slash pine was found to be much more severely damaged by ice than native loblolly and shortleaf. Possible ice damage is thus one of the factors to consider in selecting species to plant in this region.

FOREST ECONOMICS

Forest Resources

Analysis of regional problems

A brief report on regional economic problems in forestry was compiled. This report reviews past research and underscores the need for the three-pronged regional research program now under way within the Division of Forest Economics: (1) the Forest Survey, to keep up to date and analyze currently the facts of the rapidly changing forest situation; (2) studies to develop economic guides to forest management that can be used by the growing number of timber owners with an active interest in good forestry; (3) studies to find out why small-forest owners, who hold the great bulk of forest land in the Station's territory, do such a poor job of forest management, and what can be done about it.

Timber resources of the Arkansas Ozarks

Field work on the timber inventory and growth phases of the first forest survey of the 24 Ozark counties of northwestern Arkansas was completed in April 1948. Results were published as Forest Survey Release 57.

Forests cover 6.1 million acres in the Arkansas Ozarks, nearly 60 percent of the total land area. More than four-fifths of the forest area is in hardwood stands; the remainder is predominantly pine or cedar.

The timber is both small and sparse: only 17 percent of the forest is in saw-timber stands; and the sawlog volume in all stands is 5.4 billion board feet, an average of only 889 board feet per acre. Timber quality, too, is low: one-half of the softwood sawlog volume and three-fourths of the hardwood is low-grade (grade 3) material.

Total growing stock, 1.7 billion cubic feet, averages 273 cubic feet per acre of forest land. This is the volume of sound, usable wood in trees of good form 5 inches or larger in diameter. In addition, there is another 1.7 billion cubic feet of cull trees and hardwood tops and limbs. This inferior material thus comprises half of the total quantity of timber.

The principal tree species in the Arkansas Ozarks, in terms of total growing stock, are red oaks (30 percent), white oaks (23 percent), hickory (11 percent), and shortleaf pine (16 percent). Of the remaining 20 percent, nearly all is hardwood.

Current annual growth of timber averages 14 cubic feet per acre on the total growing stock, and 49 board feet per acre on the sawlog growing stock.

Timber resources of Mississippi and Tennessee

Field work on a resurvey of forest areas and timber volumes and growth was completed for the State of Mississippi in July. Following this, a survey was started in Tennessee, and 26 counties in the western part of the State were covered by the year's end. These 26 counties contain about a third of the forest land in Tennessee.

The data for Mississippi will be released early in 1949.

Forest landownership and management in central Mississippi

In 28 counties of central Mississippi, a study of forest landownership and management was made of 1,700 sample forest holdings and interviews obtained with 600 owners. A report was submitted as a Department of Agriculture publication.

The study showed that of the 6.1 million acres of privately owned forest land in central Mississippi, 75 percent is poorly managed. Only 10 percent is well managed; 15 percent is under fair management. (These management ratings were assigned on the basis of current timber-cutting and fire-protection practices.) These privately held forests make up nine-tenths of all the forest land in central Mississippi. A vast improvement in timber management is therefore needed to check their decline and build them up so that they can produce needed wood supplies.

Poor cutting practice takes many forms. On properties comprising 47 percent of the forest, no merchantable trees are left standing after logging to seed in the cut-over areas. On more than half of the forest land, no provision is made for minimum cutting diameters; and on much of the remainder, excessively small diameters are set. Pulpwood cutting on one-fifth of the forest usually takes the form of forest liquidation.

Poor fire protection consists of such conditions as these: the lack of a State-supported program in 22 of the 28 counties, the failure of owners of 87 percent of the forest to install any physical improvements for combating forest fires, and the failure of owners of 41 percent of the forest land to do anything at all to stop forest fires.

Seven out of ten owners, holding 50 percent of the forest land, are farmers. Two out of ten, holding 30 percent of the forest, are businessmen, housewives, wage earners, or professional workers. The rest belong to many occupation classes, the principal group being the forest products concerns, which own 15 percent of the forest land. Among these concerns are the two classes of owners whose management of their own land is exceptionally good: the lumber companies owning more than 40,000 acres of forest, and the pulp companies.

Analysis of Mississippi's forest situation

Looking toward a comprehensive Forest Survey report on the forests and forest industries of Mississippi, a number of special studies were made to supplement the data on forest acreage and on timber volume, growth, and drain gathered as the main activity of the Survey. Two such studies are of particular interest.

Data on forest ownership, timber management practices, and owner attitudes similar to those reported for central Mississippi, were gathered on a lighter sampling basis in the remainder of the State. This coverage will make it possible to present State-wide data in the final report.

Data on logging operations include the size and quality of trees cut and the proportion of stands removed for each timber product. Pine and hardwood operations were sampled to provide a representative cross-section of both good and poor cutting for each timber product. More than half of the total volume of pine timber cut for all products is in trees smaller than 13 inches in diameter. In pine stands cut for saw timber, the loggers take essentially all trees larger than 13 inches and three-fourths of the volume of trees 9 to 13 inches in diameter. Pulpwood cutting is even more severe, removing three-fourths of the volume in 5- to 9-inch trees alone. Hardwood cutting, though less heavy than pine in small-size trees, is equally severe when considered in terms of tree quality as well as tree size. On hardwood operations, virtually all the highest grade (grade 1) trees of sawlog size are cut, and 68 to 89 percent of grade 2 trees. The percentage varies with type of operation. However, only 36 to 46 percent of grade 3 trees are cut, except in logging for small sawmills, where the percentage is 58. This means that, regardless of product, most hardwood logging leaves a stand principally of lowest-grade trees. The end result, of course, is the gradual depletion of Mississippi's timber resources in volume and quality.

Economics of Forest Management

Guides to profitable forest management

A number of studies were begun during the year under this project. The over-all purpose is to furnish economic data and methods that the forest manager can use in choosing the most profitable alternatives in handling his forest property.

As basic material, an analysis was made of the use of interest rates in forest management, and a report was completed for publication. The rate of interest is an important factor in management decisions. In selecting rates for evaluating alternatives in forest management, it is helpful to distinguish four concepts: (1) The pure rate of interest, equal to about 2 percent, is useful in forestry primarily in weighing the relative merits of public programs. (2) The risk rate of interest is added to the pure rate as the insurance premium necessary to protect the owner from loss of income. On large properties under sustained yield management, risk is low; but on small properties it may be great. (3) The profit rate of interest is ordinarily added to the pure and risk rates as inducement to accept the risk. It comes into use in forest management when alternative investment opportunities are to be compared. (4) Individual time-preference is the premium placed by the individual upon present as compared with future goods. Where the small forest owner has a high time-preference rate, it may be impossible to interest him in good forest management as a business venture.

A study was begun to develop guides to most profitable tree utilization. Two phases of this study are to determine (1) at what stage in a tree's development it should be cut, and (2) what products the various sections of the tree should be used for. Methods were worked out which make use of margins between selling price and variable costs of production, and a search was begun for cost data that will be needed by forest managers who may use these methods.

The most profitable size of tree to grow for the production of southern pine lumber was the subject of a third study. The Southern Pine Association and some of its members helped provide data required in the analysis. If all the necessary data can be assembled, it will be possible, by use of representative examples for the southern pine region, to illustrate methods by which a company may gage the size to which it should grow its trees.

A plan was written for the project as a whole, and at the year's end was undergoing further revision. As a part of this revision, a systematic search was begun of all available library materials on the economics of forest management.

Loblolly-shortleaf pine management rules for farmers

A manuscript was prepared on farm forestry in the loblolly-shortleaf pine-hardwoods region. It tells how to size up the shortcomings of a farm woodland; how much timber to cut to obtain an annual income and at the same time improve the quality and build up the volume of salable timber; how to select trees for cutting; how to measure volume and estimate value of logs and pulpwood; how to market products under a sales contract; how to protect the forest against wildfires; how to keep records of the forest business.

Returns from well-managed commercial forests

A summary of the results of 10 years of selective timber management of 1,000 acres on the Crossett Experimental Forest shows that between 1937 and 1946 an average of 1,775 board feet (International ¼-inch rule) of pine logs has been cut per acre. The pine volume of the second-growth stands present when the study started averaged 4,807 board feet per acre. The volume removed over the 10 years was 37 percent of the original volume. In 1946, the stand averaged 6,253 board feet per acre, or 30 percent more than when the study began.

The number and size of the pine saw-timber trees also increased during the 10-year period under both a 3-year and a 6-year cutting cycle. Where a 3-year cycle was followed, the total number of pine sawlog trees increased by 25 percent, and for trees 20 inches d.b.h. and larger was nearly 70 percent greater than in 1937. The average diameter increased from 14.6 inches to 15.0 inches. Where a 6-year cycle was used, the increase in numbers of sawlog trees was 15 percent, and in trees 20 inches and larger was over 50 percent. Here the average diameter increased from 14.9 inches to 15.3 inches. During the 10-year period, heavy improvement cutting of poor-quality hardwoods, accompanied by complete fire protection, resulted in heavy restocking with pine seedlings. Many of these young pines have grown into the 4-inch or even larger d.b.h. classes during the period, insuring future cuts of saw timber.

Table 12 gives the change during 10 years in number and volume of pine trees per acre on a typical 40-acre compartment. It shows how second-growth stands will pay big dividends if advantage is taken of the growth possibilities in each immature pine tree.

Table 12.--Pine trees and pine volume per acre on compartment 55, Crossett Experimental Forest, 1938-47

Tree d.b.h. class (inches)	Trees				Sawlog volume			
	Standing, 1938		Cut, 1939-1947	Standing in 1947	Standing, 1938		Cut, 1939-1947	Standing in 1947
	Before cutting	After cutting			Before cutting	After cutting		
	- - - - - - Number - - - - - -				Board feet (Int. 1/4" rule)			
4	11.31	11.31	0.98	13.80	...	...	...	...
5	9.42	9.42	3.05	10.93	...	...	...	...
6	8.34	8.34	2.40	5.97	...	...	...	...
7	7.02	5.08	1.07	6.13	...	...	...	...
8	4.38	3.12	.54	4.94	...	...	...	...
9	3.99	3.22	.44	4.10	...	...	...	...
10	5.27	4.62	.58	4.80	...	...	...	...
11	3.94	3.52	.72	3.57	...	...	...	...
12	3.59	3.29	.47	3.92	384	352	50	419
13	3.15	2.94	.47	3.50	431	402	64	479
14	2.80	2.42	.65	3.36	470	407	110	564
15	2.70	2.52	.37	3.19	546	509	75	645
16	1.84	1.70	.19	2.35	440	407	45	563
17	2.03	1.77	.26	2.24	568	496	72	627
18	1.12	1.03	.40	1.98	364	333	129	644
19	.58	.40	.40	1.26	219	149	149	472
20	.33	.26	.42	1.03	141	111	181	442
21	.16	.07	.33	.63	80	34	161	310
22	.05	...	.14	.49	26	...	78	275
23	...	...	.07	.12	...	...	44	74
24	.02	...	.05	.07	16	...	33	49
25	...	...	...	.05	...	...	...	37
Total	72.04	65.03	14.00	78.43	3,685	3,200	1,191	5,600

In spite of the improvement cutting in 1938 and two subsequent selective cuts, the number of saw-timber trees present in 1947 was about a third more--and the sawlog volume over 50 percent more--than that before the cut in 1938. The number and volume of trees 20 inches and over have increased more than four times.

A somewhat similar study in the longleaf pine type has been planned, and the first year's cutting area marked. This study is on a 640-acre tract of second-growth longleaf pine on the Escambia Experimental Forest at Brewton, Alabama.

Returns from well-managed small tracts

Projects have been established on the experimental forests at six branch stations to determine and demonstrate the financial possibilities of managing and annually harvesting timber on small tracts like those commonly found on farms. Practices that a farmer can follow are used. The products cut annually are generally piled at the roadside, and a field day is held so that farmers can see the products and also the woods from which they were taken. Returns, costs of cutting and time required, and methods of marking and harvesting timber are explained on the ground. Often several hundred visitors attend these field days.

In addition, the staff of the Tallahatchie Branch worked with three cooperating farmers who will manage their own woodlands under agreement and follow recommended practices. Complete records of the results will be kept.

The eleventh annual harvest cut of forest products was made this year from the well-stocked (6,775 board feet, Doyle rule, per acre) farm forestry forty on the Crossett Experimental Forest. The cut per acre included 347 board feet (Doyle rule) of logs, 0.13 cord of pulpwood, 0.59 cord of fuelwood, and 1 post. On the stump these products had a value of $9.36 per acre, and delivered at the market a value of $22.57 per acre. A total of 12.7 man-hours per acre was needed to cut and deliver the products. The gross return, with no deduction for value of stumpage, was $1.76 per man-hour; or, after deduction of stumpage, $1.03 per man-hour for labor and use of equipment.

A tenth cut was made at Crossett in the poorly stocked farm forestry forty, which has been built up from 1,895 to 3,352 board feet (Doyle rule) over an 11-year period. The cut per acre was 222 board feet of sawlogs and 0.20 cord of pulpwood, worth $5.80 as stumpage, or $10.97 as delivered products. The cut has been increased from 50 percent of the growth in 1939 to 75 percent in 1948. The results from this study indicate that even the farm woodlands of the area that are now in poor condition will respond rapidly to timber management and return good incomes in only a few years.

For 2 years the Gulfcoast Branch has been managing four forties similar in design to those at Crossett. It is now evident that application of forestry principles, including selective turpentining, to small woodlands in the slash-longleaf pine region of Mississippi is practicable and profitable. Income from sale of stumpage and payments for naval stores yielded from $2.26 per acre per year on the poorest of the forties to $4.49 per acre per year on the best forty. When the stumpage was cut into wood products and the trees were worked for crude gum, the poorest forty provided 37 days of labor at $6.48 per day and the best forty 29 days of labor at $7.68 per day.

An intensive program was carried out to place each forty in the best possible shape for management. Planting was completed in open areas and undesirable scrub hardwoods were poisoned with Ammate. No costs of planting stock were assigned, since farmers can acquire up to 5,000 seedlings annually from the State without cost. About two days per acre were required for planting, and between six and seven hours per acre for oak eradication.

During the 2-year period, the total income from gum and wood products on the four forties equalled about 87 cents per man-hour for labor spent in harvesting. When spread over the total man-hours spent in harvesting, planting, oak eradication, and other cultural treatments, the return was 64 cents per man-hour.

In naval stores operations on the Gulfcoast, with labor at 60 cents per hour and crude gum at $24.83 per standard barrel, the smallest tree diameters which can be profitably worked are 8 inches for second-growth longleaf pine, 9 inches for slash, and 10 inches for old-growth longleaf. Gross gum yields for most diameter classes dropped during the second year of working, but operating costs also dropped and net yields continued to be profitable. Second-growth longleaf out-produced the slash.

The Brewton Branch in southwest Alabama completed the first year's management of second-growth longleaf pine on a "good" and a "poor" 40-acre compartment. On each forty only very limby second-growth longleaf pines and old growth with chopped boxes, made years ago, were turpentined. On the good forty extra wide faces were installed, covering about two-thirds of tree circumference; on the poor forty regular faces (about one-third of tree circumference) were used. Bark chipping and acid stimulation were practiced on both forties. Trees will be worked two years and then cut. As shown in table 13, the wide faces produced more gum than the regular faces. The advantages of the better stocking of sapling and pole-size longleaf on the good forty will not be reflected in incomes until a few years hence.

Bark chipping and acid stimulation were used on both compartments. On the good forty, wide faces were chipped once every two weeks, while on the poor forty standard-width faces were chipped every third week. Future returns on the poor forty should be higher, as out-of-pocket expenses will be less. Fuel wood and fence posts were mostly cut from cull hardwoods; the freshly cut stumps were poisoned with Ammate to inhibit sprouting. Costs and time required for poisoning are allowed for in table 13.

Table 13.--Returns from good management of two 40-acre compartments on the Escambia Experimental Forest, 1948

Area and product	Production		Labor	Gross return 1/			
				Total	Per unit	Per acre	Per man-hour
			Man-hours	Dollars			
Good forty							
Crude gum (205 faces)	5.93	barrels	138	120.85	20.38	3.02	0.88
Fuel wood	8.8	cords	138	52.98	6.02	1.32	.38
Fence posts	105	pieces	33	16.60	.16	.42	.50
Total			309	190.43	...	4.76	...
Poor forty							
Crude gum (295 faces)	3.72	barrels	148	68.39	18.38	1.71	0.46
Fuel wood	9.0	cords	152	58.05	6.45	1.45	.38
Fence posts	102	pieces	44	16.23	.16	.41	.37
Total			344	142.67	...	3.57	...

1/ Gross delivered value minus all out-of-pocket expenses.

At the Birmingham Branch in north central Alabama, a moderately stocked forty with 860 cubic feet per acre in sawlog and prop-timber trees (over 5.6 inches d.b.h.) was cut over for the first time. A yield of 363 cubic feet of sawlogs and mine props brought a total of $6.40 per acre when delivered to the plants. About 7-1/3 man-hours were required to cut and deliver logs and mine props from each acre.

A poorly stocked forty with only 380 cubic feet of prop and saw timber per acre was also improved by a light cut which removed about 12 cubic feet of these materials, worth $2.50 per acre. In addition, about a quarter of a cord of fuel wood per acre, worth $1.50 at the roadside, was cut from poor hardwoods. A total of about seven hours per acre was required to cut and deliver the products. This first cut indicates that improvement cuts on poorly stocked small holdings in this mining district will yield returns sufficient to meet interest and taxes while the stand is being improved in quality and built up in volume.

Forest Industry

Pulpwood production in 1947

As in previous years, the pulp mills drawing wood from the Station's territory were canvassed to determine the quantity and sources of the wood taken in.

Pulpwood production in the seven States reached a new high in 1947, 7 percent above 1946 and nearly three times as great as in 1936. The 4,406,000 cords produced from standing timber were 89 percent pine, 11 percent hardwood. Mississippi produced the most pulpwood--nearly half again as much as Louisiana, the second largest producer in Southern Station territory (table 14).

Table 14.--Pulpwood production in Southern Station territory, 1947

State	Pine	Hardwood	Total	Increase over 1946
	- - Thousand standard cords - -			Percent
Alabama	749.4	28.3	777.7	2.8
Arkansas	541.7	54.9	596.6	3.4
Louisiana	842.5	27.8	870.3	10.6
Mississippi	1,041.0	238.1	1,279.1	3.3
Oklahoma	29.9	...	29.9	124.8
Tennessee	42.4	98.9	141.3	4.3
Texas	667.2	43.9	711.1	15.4
All States	3,914.1	491.9	4,406.0	6.9

Pulp mill capacity also continues on the increase. In 1947, 32 pulp mills drew wood from Station territory. During 1948, two newly constructed mills were added to the list--one at Natchez, Mississippi, and one at Pensacola, Florida.

Forest industries and timber drain in Mississippi

Data obtained in Mississippi on the Forest Survey during 1947, covering wood-using plants and cutting of timber for industrial and domestic purposes, were compiled and analyzed for release in 1949.

Mississippi's lumber output in 1946 was down 17 percent from 1942, highest production year since the 1920's. The drop for the entire South (12 States) was 6 percent. Pine lumber production in Mississippi was off 37 percent, while hardwood production was up 40 percent. The changes reflect both a reduced pine timber supply in the State and an expanded market for hardwoods.

Since the mid-1930's, a dozen or more large sawmills, chiefly in the southern half of Mississippi, have shut down, but the number of medium and small mills in the State has increased about 17 percent. Slight decreases in mill numbers in the Delta and north Mississippi were more than counterbalanced by increases in the central and southern portions of the State.

Logging methods, equipment, and costs

The first draft was completed of an office report on the 1947 Crossett study of relative costs of logging standard and long logs. Because the equipment used on the study was not well adapted to long logs and the crews were inexperienced in this type of logging, it was not possible to get fully valid cost comparisons. However, some of the findings, even at this stage of the work, are significant.

Long logs can be skidded with no greater damage to residual trees and reproduction than is caused in skidding standard-length logs. Because long sawlogs can be bucked at the mill under the supervision of specialists, they yield a greater proportion of upper-grade lumber than standard sawlogs bucked in the woods. Given training and the right kind of equipment, loggers can operate more cheaply with long sawlogs than with short. However, the cost of short-length logging also can be cut by training and good equipment, and this is likely to be the more promising approach to economy for many sawmills. As regards pulpwood, even with the light equipment used in the study it was cheaper to log long lengths than 5-foot lengths. Again training and better-adapted equipment would have lowered costs further.

Regardless of the type of logging, it pays to provide ample supervision. Savings from better loading-set and road locations and fuller use of equipment can more than pay for the cost of increased supervision.

Grazing Management

Forest grazing problem in the Coastal Plain

The Alexandria and Brewton Branches critically reviewed the forest grazing situation in their territories, which are two important segments of the longleaf-slash pine Coastal Plain.

Livestock auction sales in Alexandria, Louisiana, alone totaled about 8 million dollars in 1948. The 277,000 cattle in the area use over two-thirds of the forage and feed required for the 665,000 livestock, and have a cash value four times as great as hogs, sheep, and goats combined. Cattle numbers increased about 150 percent in the 16-year period ending in 1946. About 80 percent of the cattle are of the beef type. Farm feeds and pastures in the area will maintain only half of all the grazing animals, leaving very little except forest range for the beef cattle.

A very similar forest grazing situation exists in south Alabama and west Florida, where there are some 430,000 cattle valued at about $23,000,000. The gross current annual return is estimated at $9,700,000. About 60 percent of these cattle get most of their forage from the forest range. Table 15 shows four broad classes of cattle management in relation to dependence on forest forage and herd productivity.

Table 15.--Classes of cattle management in south Alabama and west Florida, 1948

Class of management	Portion of all cattle in class	Portion of feed from forest range	Supplemental feed	Average cattle value per head	Annual calf crop	Gross annual return per head	Annual herd loss
	Percent	Percent		Dollars	Percent	Dollars	Percent
Excellent	16	10	Ample	75	75	1/ 53	3
Good	24	35	Adequate	60	75	22	3
Fair	30	80	Some	50	55	16	5
Poor	30	100	None	40	35	13	10

1/ High annual return due to inclusion of dairy cattle.

There is a definite relationship between the class of cattle management and other land uses. Poor management, depending on yearlong forest grazing, is generally found in areas of extensive forest where the range is free. Fair management occurs typically in the poorer farming areas. Excellent and good management, using forest range mainly during the best season in spring, predominate in the better farming areas like the "wiregrass" region of southeast Alabama and adjacent Florida.

Range forage

Information was assembled for an illustrated booklet to aid recognition in the field of forest range forage plants of central Louisiana. About 75 of the grasses, grasslike plants, weeds, and shrubs that furnish most of the native forage in the uplands are included. The study is a joint undertaking with the Washington Office Division of Dendrology and Range Forage Investigations.

Drought usually is not considered important in southern forest grazing. However, curtailed forage growth in central Louisiana during the dry summer of 1948 emphasized the importance of allowing for this factor in determining grazing capacity and season of grazing. Average herbage production on harvested plots was 1,114 pounds per acre in June. By October, when production normally is 50 to 100 percent greater, it was only 1,253 pounds. Total production in 1948 was only about half that in 1947.

In both 1947 and 1948, the protein and phosphorus content of fresh grass in central Louisiana remained high throughout the growing season. If the grass is ungrazed and otherwise undistrubed, the protein and phosphorus decline by the end of June to a level inadequate for good livestock growth. However, where the accumulated growth is removed every 2, 4, or 8 weeks, the nutritive quality of the fresh herbage remains fairly high (table 16).

Table 16.--Crude protein and phosphorus in herbage samples (moisture-free) on selected dates, central Louisiana, 1948

Harvesting treatment	Crude protein					Phosphorus				
	April 14	May 12	June 9	July 7	Sept. 29	April 14	May 12	June 9	July 7	Sept. 29
	- - - - Percent - - - -									
Undisturbed	11.1	8.6	7.0	5.4	4.7	0.10	0.10	0.12	0.05	0.07
2 weeks' growth	11.0	11.0	9.5	9.3	...	.13	.07	.11	.13	...
4 weeks' growth	11.1	8.8	8.4	8.4	11.2	.10	.08	.08	.10	.29
8 weeks' growth	...	...	7.1	...	9.5	...	...	.08	...	.21

The lowered nutritional value of ungrazed herbage is verified by chemical analyses of forage samples on forest range in south Mississippi. On this area, ungrazed for the past two years, the crude protein content dropped after April 1948 and remained low, within a narrow range from 5.0 to 6.1 percent, under all conditions (open, moderate, and dense timber stands, and burned and unburned range). Phosphorus content likewise remained low--0.8 percent or less after April on this ungrazed range.

Observations on forest range in central Louisiana during 1947-48 showed that bluestem grasses are the major forage in the cattle diet throughout the year. In spring and early summer, however, other grasses and weeds are important, and browse is eaten in winter (table 17). Cattle on winter range prefer to graze the fresh growth on closely cropped spots, rather than the "roughs" where they can readily get enough low-value herbage.

Table 17.--Cattle diet on forest range in central Louisiana, 1947-48

Type of plant	Winter	Spring	Summer	Indian summer	Fall
	- - - -	- Percent -	- - -		
Bluestems	70	65	54	77	76
Other grasses	7	22	33	20	14
Grasslike plants	6	5	1	1	4
Weeds	1	7	12	2	3
Browse	16	1	0	0	3

Four years' records of weight gains and losses by beef cattle on pine forest range in central Louisiana disclose that for management purposes the year may be divided into three main seasons: spring, summer, and fall-winter. The spring season lasts about 100 days, from March 15 to late June. Native forage is nutritious. Calves gain an average of 150 pounds, 2-year-old heifers 122 pounds, and breeding cows 82 pounds. These gains are high enough to warrant use of forest range by beef growers in spring.

The summer season is 105 days, from late June until early October. At this time, beef cattle just about hold their weight on forest range. Native forage alone is not good enough during summer for profitable livestock production. It may be used to maintain replacement stock or dry cows, but cows with calves and animals headed for the market need special pastures or supplemental feed.

The fall-winter season lasts about 160 days from October till March 15. It is a period of serious weight losses for all cattle that have to subsist on forest range alone. Poor forage and cold weather team up to gnaw the weight from cattle of all ages. Without supplemental feeding, mature cows may lose 25 percent of their weight. In fact, cows entering the winter season in poor condition are not greatly helped by the usual supplemental ration of 1 to 2 pounds of cottonseed cake per head per day. Cows with calves at their side during the winter months also fare badly, even with supplements.

Feeding range beef cattle in winter

Tests to find the most economic level of supplemental feed for beef cattle on forest range in winter have been conducted for 2 years in cooperation with the Louisiana Agricultural Experiment Station. Three levels of feeding were studied: high (about 3-1/2 pounds cottonseed cake per animal unit daily), intermediate (2-1/2 pounds), and low (1-3/4 pounds).

On the high nutritional level, cattle gained a few pounds in winter. These well-fed animals remained in better condition, death losses were slightly lower, and the calf crops were about 10 percent higher. The amount of beef produced during the 2-year period was 84 pounds per head greater in the high-level lot than in the other two. This extra beef was worth about $4 more per animal than the cost of feed needed to produce it. These results show that adequate winter nutrition considerably increases the productivity of beef cattle on forest range.

Cattle damage to planted slash pine

Mortality and damage caused by cattle was studied on a 3,000-acre slash pine plantation in central Louisiana. The area had been burned to facilitate machine planting, which was done in the winter of 1947-48. In July, about 46 percent of the trees were dead or dying. The principal cause was extreme drought, but shallow planting, poor planting stock, and grazing damage also took their toll. About 17 percent of the seedlings left in July were evidently damaged by grazing; 83 percent were undamaged. Burning the range prior to planting attracted the cattle to the area. This was the main reason for the high intensity of cattle grazing and presumably for the relatively high damage. The slash pine seedlings were grazed more heavily on ridges than on slopes, although the death rate from other causes was also greater on ridges.

Forest grazing in the Arkansas Ozarks

The study of forest range forage in sparse, poor hardwood stands, started in 1947, was continued in 1948. Conditions under study were burned and unburned woods at three elevations and one open bluestem "meadow." In the woodlands, bare rock occupies 20 to 40 percent of the ground surface. Leaf litter and dead grass cover 50 to 60 percent of the surface area in unburned woods, but in freshly burned woods the ground is exposed to erosion.

Weeds, mainly legumes, comprised 43 percent and browse 38 percent of total herbage production in burned woodlands. In unburned woods, these proportions were nearly reversed, being 47 percent browse and 30 percent weeds. In 1948, precipitation was 20 percent greater than in 1947. As a result, 1948 herbage production averaged 46 percent greater than 1947 on the wooded areas, and was more than double on open grass range.

The herbage in woodlands is mainly weeds and browse, and only one-fourth of it is considered edible or true forage, whereas nearly half is edible in the open grass type. This open bluestem type produced the highest amount of edible forage, with grass production five times as great as in the woodland types. Bluestem grasses were consistently preferred by cattle. Crude protein in bluestem grasses was sufficient for good livestock weight gains during April and May, but dropped below maintenance level in June. Calcium and phosphorus in bluestem were sufficient from April through June. Thereafter, cattle grazed a higher proportion of weeds with reasonably good nutritive value: asters, sunflower, and fleabane in summer, and lespedezas and tick trefoils in early fall after seed production.

These results indicate definite grazing values on forest range, but the fact remains that potential timber values are being held in check by widespread burning, ostensibly to improve grazing. The grazing capacity in the woods, however, is very low compared to that on open grass areas. A possibility which should be explored is that of developing some poor timber sites into native grass ranges.

Deer forage management

The deer forage management study is in cooperation with the Ozark National Forest, the Arkansas Fish and Game Commission, and the University of Arkansas. This study aims to develop methods and techniques of evaluating deer range conditions, and to give forest and game administrators current information on the condition of the Sylamore deer range. Overbrowsed deer ranges on the Sylamore District of the Ozark National Forest are extremely variable in browse production. In the pine-hardwood types on unprotected plots, total green weight herbage production averaged only 250 pounds per acre. Plots protected from all grazing for 2 years averaged 950 pounds per acre. Much of this tremendous increase was in weeds.

In early summer (June), green weight herbage production on severely overbrowsed range averaged only 120 pounds per acre, including all live woody and herbaceous leafage from the forest floor up to 4-1/2 feet. However, the amount of edible green browse is only 55 pounds per acre after proper use factors are applied to the production estimates. If a 125-pound deer requires 10 pounds of green browse per day, a grazing capacity of one deer per 36 acres is indicated. This is a much lighter rate than present estimated actual stocking on much of the Sylamore, particularly the two refuges.

Data on herbage production, species abundance on the deer range, and browse preferences of deer were furnished the Arkansas Fish and Game Commission for inclusion in a forthcoming publication on white-tailed deer in Arkansas.

New Chemicals for Controlling Undesirable Hardwoods

Preliminary tests on blackjack oak during 1948 compared several new plant poisons with Ammate (80 percent ammonium sulfamate). A 19.3 percent Ammate solution applied in frills (single-hack girdles) in spring, summer, and winter, killed blackjack oak crowns, although there was considerable basal sprouting. This strength of solution was fully as effective as a 32.4 percent solution.

When applied in frills in May, 2 percent solutions of sodium salt of 2,4-D and of isopropyl ester of 2,4-D, and a 19.3 percent solution of cupric sulfamate were about as effective as the 19.3 percent solution of Ammate. At other seasons they were not nearly so effective as Ammate. However, only the 19.3 percent cupric sulfamate solution appeared about as lethal as the 19.3 percent Ammate for spraying sprouts. Esteron 2,4-5 and Dowicide-G in frills did not greatly affect trees, but spraying sprouts with a 2 percent solution of esteron 2,4-5 was very effective.

In comparison with pure Ammate crystals, none of the above concentrations of 2,4-D or cupric sulfamate were very effective when put in cups or notches chopped in standing trees or applied to freshly cut stumps. A 4 percent solution of sodium salt of 2,4-D was the only new chemical that appeared to be effective when applied in notches at ground level.

Artificial Range Revegetation

A project analysis was completed for the "piney woods reseeding" project in the longleaf-slash pine Coastal Plain belt. The major forest range seeding problems are: (1) improving the seasonal forage values, particularly in midsummer and winter, (2) increasing grazing capacity without sacrificing timber values where the trees shade and smother out the forage understory, and (3) seeding and fertilizing firebreak strips through the forest. Closely related problems are control of undesirable hardwoods and seeding to improve and stabilize the soil to protect the watershed and provide food and cover for wildlife. Range seeding is so new in the South that studies are needed on the research procedures as worked out in the West for: (1) development of improved or promising species and strains, (2) testing species adaptability, (3) methods of planting and culture, (4) evaluation of sites and site factors, and (5) management and maintenance of seeded ranges.

Work on species by the Bureau of Plant Industry, Soils, and Agricultural Engineering, cooperating with the Southern Station and the Mississippi Agricultural Experiment Station at McNeill, Mississippi, showed that big trefoil, sericea, common and Kobe lespedezas, lance crotalaria, hairy indigo, carpet grass, Dallis grass, Bahia grasses, tall fescue, and hirta grass are promising on fertilized plots and merit further trial under forest range conditions.

Fertilizing central Louisiana pine forest range with 300 pounds of 4-12-8 per acre doubled the yield of native forage and helped to establish seeded stands of lespedeza, carpet grass, and Dallis grass. Fertilizer increased the stand and yield on forage plots seeded to these species by two-thirds or more. Forage production on areas that were burned, fertilized, harrowed, and seeded was 4,500 pounds per acre as compared to only 1,900 pounds on untreated areas. Fertilized areas were conspicuous because cattle kept grazing the tender new grass shoots all summer and fall, long after unfertilized grasses had dried up.

In south Alabama, firebreak strips were fertilized in April 1948, using basic slag at varying rates. Only a few spots were grazed closely enough by cattle to serve as effective firebreaks, but basic slag is slow-acting, and better results should show up in the next year or two.

Labor and equipment costs for an 8-foot wide strip were $9.68 per mile plus fertilizer cost. Basic slag applied to such a strip at the rate of one ton per acre costs $12.16, or a total of $21.84 per mile. Half of the breaks were burned before fertilizing at an additional cost (including plowed firelines) of $19.76 per mile.

FOREST UTILIZATION SERVICE

The Forest Utilization Service, acting in part as a southern outpost of the U. S. Forest Products Laboratory and in part as an integral component of this Station's research program, carried forward its functions during the year on a varied front. Personal and mail contacts were made with hundreds of people interested in and searching for information on the utilization of forest products. Assistance and information were provided to these people on practically all major phases of forest utilization. Further, FUS advised, aided, and participated in the parts of the Station's research program which emphasize forest utilization. Some of the major aspects of the year's work are discussed briefly under the following headings.

Forums, Clinics, and Meetings

The Forest Utilization Service, in cooperation with the Texas Forest Service Forest Products Laboratory, developed a forum at Lufkin, Texas, on wood hydrolysis. A similar forum was held also at Birmingham, Alabama. About 125 lumbermen, forest landowners, and others attended these meetings. The technical requirements and commercial possibilities of wood hydrolysis were discussed by FUS and U. S. Forest Products Laboratory personnel.

Three training sessions in hardwood log grading were conducted in cooperation with lumber companies, State Foresters, and national forest administrators. These were held in Mississippi, east Texas, and the Arkansas Ozarks.

Several well-attended forums on seasoning were participated in by the FUS staff. The largest was sponsored by FUS in connection with the annual meeting of the Arkansas Wood Products Association at Little Rock, Arkansas. At the meeting, wood-seasoning experts from the U. S. Forest Products Laboratory and industrial companies held discussions on seasoning problems and techniques. The Texas Dry Kiln Club, which was organized by the Texas Forest Service as a result of a dry kiln course sponsored by the Forest Utilization Service and the U. S. Forest Products Laboratory, held two sessions dealing with air and kiln drying. FUS personnel participated in both programs.

FUS representatives presented papers at the meetings of the Southern Box and Crate Association, Arkansas Wood Products Association, Texas Chemurgic Council, New Orleans Academy of Science, Texas Dry Kiln Club, the Short Course in Gas Technology at Kingsville, Texas, the Logging and Milling Short Course of the University of Tennessee, and the annual meeting of the Arkansas Extension Service agents. Subjects covered were waste utilization, wood hydrolysis, development of gas kilns, use of low-grade hardwoods in construction, and fence post preservative treatments. FUS also arranged for and handled a demonstration of logging equipment adapted to small operators at the Logging and Milling Short Course held by the University of Tennessee.

Low-Grade Hardwood Utilization by Small Sawmills

A start was made on the development of a cooperative project in east Texas on the utilization of low-grade hardwoods by small sawmills. The project will include study of the occurrence of specified standard primary products in trees and stands by tree classes, possibilities of alternate primary uses for individual trees, and the sawing of standard round products to determine actual content of these in terms of usable, large, or small clear pieces of wood. Subsequent studies will investigate marketing possibilities and the economics of production.

The Texas Forest Service Laboratory and the Forest Products Laboratory are cooperating with the Station in the study. The Texas Forest Service has set up a sawmill on the Stephen F. Austin Experimental Forest for carrying out sawing experiments. The work of the U.S. Forest Products Laboratory in grades for factory logs was used in developing working specifications for the various classes of products. The standard product specifications include four grades of factory lumber logs, three grades of tie and construction-timber logs, one grade of so-called local-use logs, and two grades of bolts suitable for sawing conversion. This is a very important project which could lay the basis for widespread work of this kind throughout the South.

Log Grades

To test the practicability of grading and to check estimates of grade yield, FUS conducted tests in four sawmills in Mississippi, Tennessee, and Arkansas. These tests showed that the "Interim Sawlog Grades for Southern Hardwoods" prepared in 1946 provide a good base for log segregation, but the grade yields realized are from 6 to 20 percent higher than the rules specify. Some of this difference is due, however, to the failure to appraise hidden defects accurately when the logs are graded.

The latter conclusion, along with other evidence, focused attention on the need for better definition and identification of hardwood defects. To answer this need, available information supplemented by some new work was brought together into a manuscript. This manuscript defines, identifies, and evaluates the significance of all log surface and log end abnormalities. It will be published in 1949.

Container Industry Inquiry

A limited inquiry into the agricultural box and crate situation in this region was conducted by FUS and the Forest Products Laboratory. The object was to get a picture of the status of this wood-using industry and an understanding of production problems involved. The Southern Box and Crate Association and the Illinois Central Railroad assisted in arranging for the inquiry.

The final report has not as yet been prepared; however, in this area no pressing technical problems were revealed, either in production or design. Rapid change-over from rail to truck shipment is occurring, but this has not been reflected in demand for change in container design. Difficulty with present containers in rail shipment appears to be related more to car loading than to design. The industry appears to have plenty of capacity, one estimate being that it is now running at about 60 percent of full production. Raw material supplies are in the main reported to be adequate, although quality decrease is becoming serious in some areas. This aspect is complicated by the current labor and timber shortages, which make it impracticable for the plants to screen out all of the less profitable grades of logs. In general, logs are equal to or superior to sawmill logs, except for sweep. Log prices at the end of 1948 averaged about $35 per thousand, Doyle scale.

Mississippi Delta Secondary Wood-Using Industries

FUS made a short study of the secondary wood-using industries in the Mississippi Delta, in connection with a comprehensive survey of the resources of the area being made by the Delta Council. Very little secondary manufacture is present, the main reason being shortage of electric power and seasonal labor supply. At present, the raw material flows to nearby centers such as Vicksburg and Natchez, Mississippi, and Memphis, Tennessee, where there are extensive remanufacturing plants.

Wood Molasses

The interest that was developed in 1947 regarding the possibilities of making wood-sugar molasses continued high in 1948. FUS met with a number of individuals or groups to discuss the process and commercial possibilities. Several of the interested parties visited the Forest Products Laboratory. In general, promotion sought to bring a selected group of possible entrepreneurs to the point where they could make their own decisions as to the desirability of entering this business. One important factor on which information is currently lacking is evaluation of commercial possibilities of wood molasses.

To meet the latter need, commercial distillers tested both hardwood and softwood molasses. With present plants and processes, it appears that pine molasses has about 90 percent and oak molasses about 50 percent of the value of blackstrap molasses for making alcohol. To test molasses as a livestock feed, palatability trials were made in 1947 and 1948 at Alexandria, Louisiana. The 1948 test confirmed previous ones made at Alexandria and at State College, Mississippi. Some of the cattle ate the molasses readily, but most of them had to develop a taste for it. They liked it best when mixed with cottonseed meal or roughage like cottonseed hulls. Older animals ate the food more readily than young ones. No ill effects were noted in any test.

During the spring of 1948, the Forestry Department of Mississippi State College shipped seven cords of wood to the Forest Products Laboratory. This wood was converted to molasses and returned to State College, Mississippi, where cooperative arrangements have been entered into for feeding it to beef cattle as a finishing ration. A 120-day test is being conducted by the Mississippi Agricultural Experiment Station's Department of Animal Husbandry. The test was started in December.

Interest in feeding studies was shown by the Alabama Polytechnic Institute, University of Arkansas, and Texas A & M. The difficulty in following up on this interest has been the lack of molasses. Only the very small production obtainable from the old pilot plant at the Forest Products Laboratory is available. Recently, however, the Forest Products Laboratory and the Tennessee Valley Authority entered into a cooperative agreement under which TVA will install and operate a pilot plant with about four times the capacity of that of the Laboratory plant. This plant should be in operation by late 1949. Most of the molasses from the plant will be available for testing purposes in TVA territory.

Wood Waste Utilization

In cooperation with a lumber company, a pulp company, and the Southern Pine Association, a study was made of the actual amount of waste suitable for pulping developed at a large sawmill. Logs were peeled and segregated by six size classes. For each size class the commercial product was tallied, and the waste collected and weighed. Because this study showed a surprisingly low waste figure, it was repeated with logs deemed more typical. The result, however, was the same.

The procedure involved determining the waste for each log size class and then, from a study of the pattern of log sizes sawn over a long period by this mill, estimating the annual volume of waste and the amount produced per thousand board feet of logs of different sizes. The standard measure for expressing units of waste was the amount of bark-free chips which would be produced from an average cord of southern pine round wood, which weighed (green, without bark) 5,000 pounds at 100 percent moisture content. The oven-dry weight of the waste was determined and then recalculated in terms of the above average round cord. This was called an equivalent cord. It was found that waste from this sawmill was only 0.18 cord per thousand board feet, green lumber tally. Remanufacture of a portion of heavy waste into strips and squares reduced this figure by about one-third. The following table shows the waste suitable for chipping.

Table 18.--Chippable waste produced by a band mill with resaw, from peeled southern pine logs

Log class (inches)	Log diameter (inches)	Actual waste by log classes		Calculated total waste as determined by log intake pattern [1]	
		Per M bd.ft. green lumber tally	Per M ft. Doyle scale	Per M bd.ft. green lumber tally	Per M ft. Doyle scale
		- - - - - - - Equivalent cords - - - - - - -			
8	7-8-9	0.23	0.52	0.027	0.041
11	10-11-12	.15	.26	.053	.082
14	13-14-15	.21	.29	.065	.099
17	16-17-18	.16	.21	.024	.038
20	19-20-21	.17	.19	.012	.017
Average				0.181	0.277

[1] Of the mill studied: data given as example only.

Following this study, a more complete project was undertaken. This work was designed to measure the waste at mills of various size classes with varying types of equipment. Sixteen sawmills cutting pine were selected in Arkansas and Louisiana and agreements made with the operators to conduct a study of peeled logs. The four classes of mills were band mills with a resaw, circular mills with a resaw, circular solid-tooth mills without a resaw, and circular portable mills.

Work was completed during 1948 at ten of these mills. More than 1,250,000 pounds of peeled logs were sawed. From these logs 250,000 pounds, green weight, of heavy waste were obtained, 95 percent of which was suitable for pulping. The following table shows the percentage of the green weight of logs of various size classes recovered as waste at mills of the different classes. Contrary to general belief, the amount of heavy waste does not appear to vary significantly between the different classes of mills. When this study is completed, the results will give very valuable basic information for use in helping put waste utilization on a rational basis in this area.

Table 19.--Percentage of green weight of peeled southern pine logs in slabs, edging, and trim

Log class (inches)	Log diameter (inches)	Type of mill			
		Band with resaw	Circular with resaw	Circular without resaw	Circular portable
		Percent			
8	7-8-9	30	27	26	28
11	10-11-12	22	20	20	25
14	13-14-15	18	19	15	21
17	16-17-18	18	15	14	15

There were some local developments in waste use. A company in Mobile, Alabama, developed a process for making plastic from sawdust. The yield of 1,600 pounds of plastic per ton of oven-dry sawdust is reported. A company in Memphis has installed a "Presto-Log" machine for making briquettes. A company in Arkansas has installed presses and expects to be producing a dry-form resin-bonded wasteboard by March 1949. The Agricultural and Industrial Board of the State of Mississippi has formed a committee to study waste utilization prospects.

Barkers

In the process of waste utilization, removal of bark constitutes a problem. A pulpwood contractor in the Mississippi Delta has just installed a hydraulic barker for hardwood pulpwood. A company at Picayune, Mississippi, has developed a barking machine with a floating head of the hammer type; it is designed primarily for pulpwood. In an initial test run, 14 bolts 5.3 inches long and 4 to 10 inches in diameter were well peeled in 6½ minutes. An interested operator cooperated with the machine company to make a 60-day test run to perfect the machine, and increased the output to about 20 cords per day. When the machine is finally perfected, the company plans to install them at numerous wood-shipping points. A company in Alabama has developed a pilot model of a small sawlog barker that should bark about 20 M board feet of logs per day. A number of small preservation plants have put in drum barkers for fence posts, and there is interest in the use of the small chain-type fence post peeler.

Sawmills

In the past year, FUS has observed the operations of a number of sawmills especially adapted to cutting small timber. There are two small sash gang mills in operation, one in Arkansas processing logs and one in Mississippi handling flitches. The performance of the former has been unsatisfactory because of the difficulty in changing saws and the trouble in handling crooked logs. Power requirements have been very high. In this field, a number of box plants have multiple circular gang sawmills designed to produce rail and post stock from veneer cores. One of these is now running on hardwood cordwood. These mills have continuous feed; the cordwood mill saws bolts at the rate of about 30 lineal feet a minute.

A very interesting operation is carried on by a company in Arkansas. Two specially designed units handle logs 6 to 10 inches in diameter in standard 8-foot lengths. The installation includes a twin-edger type headsaw which slabs two sides of the log, a band resaw which slabs a third side, and another band resaw with a "merry-go-round" which works down the cant to a point of complete utilization. This method of sawing permits recovery of close to maximum grade yields. The two units require 23 men, and produce about 65,000 feet of 4/4 lumber per day. Yields per cord run about 700 feet.

Preliminary study was made of a pilot installation of a circular mill in Alabama with many exceptional advanced features. It is operated by hydraulic equipment controlled by one man. Production from an average run of logs is about 20 M board feet per day. Because of orders for other equipment and material shortages, the company which designed this mill will not place it on the market immediately. These new developments in mills, together with many instances of reconditioning existing standard mills, are indications of the wave of technological improvements now gaining momentum and designed to gear production facilities to poorer timber.

Seasoning

One of the most publicized southern developments in the seasoning field has been the recent rapid expansion of direct gas-fired kilns. This development has taken place since 1944, when there were only three gas-fired kilns in the South. Many claims are being made for these kilns on the grounds of simplicity, efficiency of operation, fuel economy, low cost of installation, and quality of products.

FUS has followed this development and has inspected nearly half of the 200 gas kilns installed in this territory. FUS and Forest Products Laboratory technicians cooperated on a detailed study of five of these kilns--four in Arkansas and one in Mississippi. Final results are not yet available, but general conclusions are that the gas-fired kilns, as now constructed and operated, have a very definite place in the industry. They are particularly well adapted to drying previously air-seasoned lumber, especially where precision drying is not required.

There is no question that these kilns, most of which are of natural draft type, could be improved both as to construction and as to control. However, if they were built on the same standards as other kilns, they probably would not be cheap to build. Fuel costs, however, are low. One oak flooring plant reported that this cost, during summer months, averaged 44 cents per thousand board feet.

Another seasoning method on which there was much publicity is the so-called "boiling-in-oil" process. A contractor building houses in Louisiana installed a plant and was able to dry green pine to 7 to 12 percent moisture content in 6 hours. Tests of the dried lumber showed some case-hardening and a little oil pick-up. Neither of these items is considered a serious matter when the lumber is to be used for interior trim and not resawed. Costs of seasoning were reported to be relatively high, around $10 per thousand, but this is not exorbitant in view of the fact that cheap green lumber could be dried on a schedule controlled by the contractor.

Preservation

The twelfth annual inspection of the test fence on the Harrison Experimental Forest was made by the Forest Products Laboratory technicians. The following tabulation[1] illustrates the kind of results being obtained from this test. It is based on the tenth annual inspection of 24 preservatives being tested in a fence line at the Harrison Experimental Forest. Of the untreated posts installed as controls, none are serviceable any longer; their average life was 3.1 years.

Percent of treated posts serviceable after 10 years	Number of preservatives
100-90	15
89-80	3
79-70	2
69-60	1
59-50	1
49-40	1
39-30	1

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[1] From data in table prepared by J. O. Blew, Technologist, Forest Products Laboratory, and published in the "Proceedings of the American Wood-Preservers' Association," April 1947.

Because there have been changes in the production of creosote and because there are many other wood preservatives on the market, it was decided to start a new series of tests. Accordingly, 1,500 southern pine posts were cut on the Harrison Experimental Forest and shipped to the Forest Products Laboratory for pressure treatment with 40 different preservatives. As a sidelight, 30 percent of these posts were found to contain incipient decay when they were treated. This indicates that it is dangerous to attempt to season fence posts in this area during the warm, wet season without special precautions.

In the search to find new preservatives and methods of application, the Forest Products Laboratory installed in the South a series of fence posts treated with the double-diffusion process. This promising process consists of treating the posts first with one water-soluble chemical and then with another: the two chemicals react inside the post to form an insoluble compound that is poisonous to fungi and insects.

The whole process of local testing of a number of species with simple methods received great stimulus with the formation of two informal cooperative groups. One, formed in 1947 under the auspices of the TVA, included representatives from the States of Mississippi, Alabama, Georgia, and Tennessee. Another, sponsored by the Texas Forest Service Laboratory, included representatives of Louisiana, Arkansas, Oklahoma, and Texas. The eastern group met at Auburn, Alabama, and reported that installations had been made in Alabama and Georgia with posts treated by cold soaking with 5 percent pentachlorophenol. Mississippi and Tennessee installed similarly treated posts later in 1948. A similar test of posts treated with copper naphthenate as a preservative will be installed during the coming year. The other group developed a plan for testing 11 species by the cold-soaking method using a 5-percent oil solution of pentachlorophenol as a preservative. Personnel of both the Forest Products Laboratory and FUS participated in these conferences.

FLOOD CONTROL SURVEYS

Flood control investigations have been under way at the Southern Station since 1937, except for the period 1943 to 1947, when they were suspended on account of the war. Under the program which was reactivated in 1947, this Station handles forestry phases of these investigations in a 14-State territory from North Carolina to Texas and north to Kentucky and southern Missouri. The Station has primary responsibility for the watershed surveys in most of the major tributaries of the lower Mississippi River and adjoining territory.

Flood control investigations are of two kinds: (1) a preliminary examination to determine need and feasibility of watershed treatment in aid of flood control, and (2) a detailed survey to formulate measures for run-off reduction and soil erosion prevention and to evaluate costs and benefits. Survey reports which show benefits in excess of costs go to Congress and are the basis for authorization and funds to accomplish recommended work. These flood control studies are an important medium for extending conservation practices and better land use on a large scale throughout much of the South.

Progress on Current Surveys

During 1948 progress was made on surveys of: (1) the White River and tributaries above Norfork, Arkansas, (2) the Gasconade River (Missouri), and (3) the Homochitto-Buffalo River (Mississippi).

The survey of the upper White River watershed--suspended during the war years--was brought to near completion in 1948. Full use was made of prewar data, but flood damages and benefits as well as watershed treatment needs were reappraised in the light of current conditions and prices. By the year's end, a first draft of a report and appendix, presenting survey findings and procedures, was substantially complete.

The resumption of work on the upper White River project required some additional field inventories. Among these were: (1) a study of small detention reservoirs for flood control, and (2) a survey of sediment production from highways. The former involved selection of potential reservoir sites using aerial photo techniques, and field examination to determine suitability of sites and probable construction costs. In general, owing to scarcity of sites and relatively high cost per acre-foot of storage, there appears to be only limited opportunity for small detention reservoirs in this watershed.

The road erosion survey covered more than 1,400 miles of highways and improved roads in the upper White and Gasconade River watersheds. Although a substantial amount of erosion was observed in these drainage basins, roads in the aggregate were found to be a relatively minor source of sediment.

A rush survey of the Gasconade River was completed in September as a part of a basin-wide survey of the Missouri River watershed undertaken by the Soil Conservation Service. This stream drains hilly country in the Missouri Ozarks and empties into the Missouri River some 107 river miles above its mouth. Data and recommendations for the Gasconade watershed were incorporated with those for contiguous units in the lower Missouri River basin. Narrative sections, describing watershed and forest conditions in the Ozark region, were supplied for the Missouri River report.

The survey of the Homochitto-Buffalo River watershed in southwestern Mississippi, though delayed several times, was well under way by the end of the year. Field reconnaissance was completed and work plans, including sampling procedures for classifying watershed lands, were formulated. First accomplishments included analysis of streamflow and precipitation records, measurement of floodplains and stream channel reaches, and preliminary calculations of flood damages.

Preliminary observations in the Homochitto-Buffalo River basin reveal that marked changes in land use have taken place in the last decade. These for the most part reflect trends and adjustments which are occurring in many parts of the South, though usually on a smaller scale. There have been substantial shifts from row crops to grass and trees, apparently because of an exodus of farm labor during the war years. The main flood problem appears to be bank cutting, which is locally quite serious. Overflows apparently are less frequent, partly because of improvement in cover conditions throughout the watershed and less intensive use of floodplain lands.

Cooperative Relations with Other Agencies

The Station works closely with the Soil Conservation Service and assigns men to handle forestry investigations on SCS projects.

Station personnel detailed to the survey of the Savannah River watershed (Georgia, South Carolina, and North Carolina) completed field work on the forestry phase as well as compilation and analysis of data. The report for this project will be finished early in 1949.

Review of survey work plans and flood control recommendations was an important activity during the year. Preliminary examination reports for the Missouri, upper Mississippi, and Red River basins were reviewed as well as work outlines for proposed surveys of the

Brazos River (Texas), Little River (tributary to the Brazos), Salt Fork River (Kansas and Oklahoma), and the Apalachicola River (Georgia, Alabama, and Florida). Formal reviews were also made of completed survey reports for the Osage River (Kansas and Missouri), the Grand (Neosho) River (Kansas, Missouri, and Oklahoma), the lower Arkansas River, and the Bosque River (Texas). The Station also participated in conferences to harmonize forestry proposals for the Pee Dee River (North Carolina).

Numerous contacts were made during 1948 with the Corps of Engineers, Weather Bureau, Geological Survey, State conservation and forestry agencies, land-grant colleges, soil conservation districts, and other interested groups. Mostly these were for interchange of data or consultation on survey techniques or findings.

Related Activities

Station advice and assistance were supplied in furthering progress in flood control operations now under way in the Little Tallahatchie and Yazoo River basins in north Mississippi. The survey for these two watersheds, completed prior to 1943, resulted in authorization in the 1944 Flood Control Act of some $26,000,000 of Federal funds for comprehensive watershed improvement work.

The Station participated in a series of hydrologic conferences sponsored by the Subcommittee on Hydrologic Data of the Federal Inter-Agency River Basin Committee. These conferences were to review and evaluate agency proposals for stream-gaging, precipitation, and other hydrologic stations. Forest Service recommendations were submitted through cooperating agencies for the conferences in Cincinnati and Fort Worth. The Station was represented at the conferences in Tulsa, Atlanta, and Vicksburg, and had chairmanship of a work group at the latter meeting. The Station also computed and summarized a considerable volume of conference data from the Atlanta and Vicksburg meetings.

EXPERIMENTAL FOREST DEVELOPMENT

Alexandria

The old military camp area which has been under consideration for an experimental forest was declared unsafe for forestry operations and negotiations were dropped. The search for another area resulted in the selection of a privately owned tract under option to the Forest Service and several areas of national forest and private lands adjacent to the J. K. Johnson tract. A formal request has been made for their acquisition and dedication as an experimental forest.

Brewton

Through the cooperation of the Alabama Department of Agriculture and Industries, a soils map of the Escambia Experimental Forest was made. A reproduction survey of the Forest made with the help of forestry students of Alabama Polytechnic Institute located areas that still lacked adequate reproduction, in spite of the generally excellent catch from the 1947 seed crop. Because of the good seed crop prospects in 1948, these areas were burned in September to provide a better seedbed. Light fire-line equipment and small crews were used; the cost was 63 cents per acre. Two temporary buildings, a tool house and an oil house, were built, and minor road work was completed.

A start was made on the preparation of a general management plan for the Experimental Forest.

Birmingham

A management plan for the Flat Top Experimental Forest was completed.

An improvement cutting for sawlogs was made on 250 acres, and a similar cutting for mine props was made on 60 acres. Of the material cut, 82 percent was low-quality hardwood, usually unmerchantable outside the mining territory, and 18 percent was low-quality pine, mostly Virginia pine. The average cut per acre was 157 cubic feet of saw timber and 120 cubic feet of props. Average stumpage value per cubic foot was 3.6 cents for saw timber and 1.6 cents for mine props. On a board-foot basis, the stumpage value for saw timber was $5.69 per M, International ¼-inch rule. Total stumpage value of both products was $7.50 per acre. Since the material removed is worthless in many areas, this cutting indicates the opportunities available within the mining area to make needed stand improvement cuttings at a profit.

Crossett

All planned cruising, marking, and cutting in both units of the Crossett Experimental Forest was completed on schedule. There were no changes in improvements or facilities in 1948.

Delta

The Mississippi Highway Commission made further improvements on the roads on the Delta Experimental Forest. Most of the tract is now accessible by automobile throughout the year. Additional fire protection has been obtained by disking a $4\frac{1}{2}$-foot fire line around the boundary.

About 100 cords of firewood from cull and low-grade trees and tops of trees cut for sawlogs were sold to local cotton plantations, and efforts are being made to increase annual sales of firewood to 500 cords in order to hasten improvement of the forest.

East Texas

A Corley mill was purchased by the Texas Forest Service and set up on the Stephen F. Austin Experimental Forest for cooperative use in the study of the utilization of inferior hardwoods. Base maps of the forest and administrative site were completed. In spite of an exceptionally dry fall, less than 3 acres were burned and only minor damage resulted. Planting totaling nearly 10,000 seedlings failed because of drought.

The adjoining Kurth tract, leased for experimental purposes, had four fires but no plots were lost.

Gulfcoast

The Harrison Experimental Forest was kept on a maintenance basis. At the McNeill, 2.5 miles of main road were graded and gravelled and an additional 0.5 mile graded. One bridge and 9 culverts were constructed, and considerable side-ditching was done.

Ozark

Title to a 750-acre tract of forest land 16 miles south of Harrison, Arkansas, to be known as the Koen Experimental Forest, is expected to be obtained before July 1, 1949. Exterior boundaries have been surveyed and corners and land lines have been established. A map has been prepared showing the forest types, stand conditions, roads, trails, springs, buildings, and fences. Arrangements for fire protection have been made, and the tract will be ready for use as a field laboratory as soon as title is obtained.

The Sylamore Experimental Forest, which will be used for studies not requiring frequent attention, was surveyed. The object was to show merchantable volume by species and forest type and the occurrence of unmerchantable trees, as a basis for a commercial improvement cutting. The working plan that was prepared for this cutting includes estimates of volume to be removed and instructions for stand betterment work with Knutson-Vandenberg funds.

Tallahatchie

A report requesting withdrawal of a portion of the Holly Springs National Forest for the Tallahatchie Experimental Forest was prepared and submitted but has not yet been officially approved. A headquarters site on this area has been selected, and plans prepared for its development. Road plans have also been prepared.

COOPERATING AGENCIES

Bureau of Plant Industry, Soils, and Agricultural Engineering

Tree pathology

Fusiform rust of southern pines.--Improved control of the rust in nurseries seemed assured after further trials with relatively new chemicals and adhesives. Ten weekly sprayings with five different materials reduced rust infection to 1.2 percent or less, as compared to 2.9 percent for Bordeaux mixture and 4 to 9 percent for unsprayed controls. Six treatments with Fermate and Zerlate, applied with reference to weather, reduced disease to less than 2 percent. The latter materials particularly, with Santomerse as a spreader and adhesive, appeared to have several definite advantages over spray solutions used heretofore at nurseries. In general, results confirmed those of last year and demonstrated that serious rust infection in nurseries is avoidable.

A check on graded nursery stock indicated that important amounts of infection were likely to be overlooked. Since grading was as thorough as is considered practicable and some latent infection undoubtedly escaped the detailed reinspection, the need for using recommended control sprays was further emphasized. Another study showed that the average green weight of infected seedlings was appreciably greater than that of uninfected ones, thus substantiating the observation that large seedlings are more likely to be cankered than are smaller ones.

Comparisons of weather data with yearly prevalence of infection in slash pine nursery stock revealed that widespread pine infection was favored by warm weather in late winter, particularly in March, followed by cool damp weather in April. The most effective spraying schedules for nurseries apparently are those that (1) defer treatments until rust first appears on leaves of oaks in the vicinity of the nursery, (2) withhold sprays whenever daily average temperatures are not above 56° F., and (3) time the application of sprays so as to precede periods of high humidity or general precipitation. Such data are of value not only to nurserymen responsible for large-scale production of slash and loblolly pines but also to landowners interested in timing the pruning of infected branches to years of heavy infection.

Plantings of slash pine seedlings from healthy, 1-canker, and 2-or-more-canker parent trees had 26, 34, and 33 percent of the trees infected, respectively, after 3 years in the field. A second test involving 2-year-old slash pine showed 5.3, 10.0, and 4.0 percent infection, respectively. Present evidence is that a high degree of resistance cannot be expected from trees that originate as seed from a healthy parent.

Five geographic strains of slash pine showed a range of 23 to 36 percent of the trees infected after 5 years in the field. A more comprehensive series of strains from six sources ranged from 3.0 to 5.4 percent infection when lifted for planting. These and additional strains of slash pine of a south Florida and western Cuba type are now in field tests at several locations.

Prescribed burning, in the form of single fires, had an initial effect of killing cankered branches and reducing the number of cankered trees in 3- to 6-year-old plantations. However, later comparisons of burned and unburned areas showed a greater number of new infections where fire had been used. Any recommendation that fire be used as a canker control measure still appears unjustifiable.

Nursery diseases.--Exploratory soil disinfection trials for the control of root disease at the Ashe Nursery revealed treatments that greatly reduced root rot, increased seedling stands, and gave striking control of weeds. The earliest tests, dismantled in early 1948, were on the whole confirmed by a later series dismantled in late 1948.

Striking control of root rot was obtained with two fumigants, chloropicrin and ethylene dibromide. Formaldehyde and allyl alcohol ranked next in effectiveness but were significantly inferior to the fumigants. Various fungicidal materials and a third fumigant were largely or entirely ineffective in root rot control.

Increased seedling stands were obtained from plots treated with allyl alcohol. In the early tests, this increase represented over 30 percent more plantable slash pine seedlings than from untreated areas. Improvement in stands through the use of allyl alcohol seemed due in part to a reduction in pre-emergence and early damping-off losses.

Highly successful control of weeds until early summer to midsummer was obtained in all plots treated with allyl alcohol. Zinc trichlorphenate also showed a clear-cut reduction in weeds, but its effect was markedly inferior to that of the alcohol. There was evidence that the latter material might prove useful in supplementing mineral oil sprays in nursery weeding operations.

In laboratory investigations, the supposition has been followed that a nematode and fungus complex may be the cause of the root rot. At least 8 genera of nematodes were found associated with diseased pine roots from the nursery. One type, generally considered saprophytic, was found attracted to the root tips of young longleaf seedlings. Four of the types were successfully cultivated, free of other nematodes, on plates of malt agar. The nematode population around pine roots was found to fluctuate throughout the summer, both in total and relative numbers of the different types. Three fungi isolated frequently from diseased root tissues were Torula sp., Fusarium sp., and Sclerotium bataticola. Inoculation experiments with nematodes and fungi, alone and in various combinations, were initiated on longleaf pine.

Products pathology

Building decay studies.--The factors that influence absorption and penetration of on-the-job applications of preservatives were studied in order to define better their limits of usefulness for the control of decay in exterior woodwork. A proprietary plastic coating was found that effectively prevented oil penetration into wood, thus insuring accurate absorption and penetration data on selected surfaces of test material. Some preliminary results were:

(1) Dip and soak treatments of pine apparently follow the trends established for pressure treatments. Absorption and penetration were mainly from the transverse surfaces, and radial penetration was appreciably greater than tangential. The latter favors the flat-sawn type of lumber that is currently common.

(2) Some pieces of pine heartwood treated almost as readily as sapwood, but they were the exception.

(3) Better absorptions usually were obtained with straight preservative solutions than with similar solutions having moisture-repellent materials added.

(4) The treatability of different pieces of pine sapwood often varied greatly. In general, it was not possible to correlate good and poor treatability with any readily discernible wood characteristic. Such differences point to an important limiting factor in the use of brush and dip treatments if more thorough methods are practicable.

Inspection of test units showed no decay after 7 years of exposure in material soaked for 15 minutes or longer in pentachlorophenol. Units similarly treated with copper naphthenate or phenyl mercuric oleate had only minor decay. Appreciable amounts of decay were found in units treated 6-1/2 years ago by brush with copper naphthenate or pentachlorophenol. Brushing had been beneficial, but better methods of on-the-job applications were indicated for permanent structures, if at all feasible.

New installations included the construction of a small test building for studying the factors influencing decay hazard in wood siding, and a porch flooring test to determine the effectiveness of on-the-job preservative applications and of leading joints in reducing decay hazard. Owing to several questionable design and construction practices, wood siding and porch difficulties have been increasing in the South. The new studies are designed to determine the relative importance of these practices and to arrive at recommendations that will insure satisfactory service from wood used in siding and porch construction.

Inspections were made and practical advice on building decay control given to a number of private owners in several southern States, as well as to large public building agencies in Texas, Tennessee, and North Carolina.

Pulpwood deterioration.--In cooperation with the Forest Products Laboratory and Gaylord Container Corporation, Bogalusa, Louisiana, studies were started on length and time of year of storing slash pine pulpwood in relation to deterioration and quality and yield of pulp. Early results on peeled and unpeeled pulpwood cut in late July and stored in ricks were:

(1) After 2 months of storage, sapstain had discolored over 30 percent of the volume of peeled pulpwood as compared to about 11 percent in unpeeled. An early stage of decay was somewhat more common in peeled than in unpeeled bolts but had caused little if any reduction in specific gravity. Average moisture content of peeled bolts had dropped to about 35 percent, oven-dry basis, whereas the unpeeled averaged 116 percent, or only 4 percent less than at the time of cutting.

(2) After 4 months of storage, sapstain still was more prevalent in peeled than in unpeeled bolts but had become secondary to decay as a deterioration factor. Although decay volume differed little between peeled and unpeeled bolts, decay in the latter often was of a more advanced type. Losses in specific gravity still were not pronounced, but reductions of 5 to 10 percent were evident occasionally, particularly in unpeeled bolts. Moisture content of unpeeled material was still high, approximating 100 percent. That of peeled bolts showed little change from the 2-month storage period.

(3) Decay in all material seemed to be caused largely by one fungus, Peniophora gigantea.

(4) Under the conditions of these tests, peeling showed no advantage in reducing deterioration in pulpwood stored for short periods of 2 months and possibly 3 months. Thereafter, decay tended to progress most rapidly in unpeeled bolts, and there was evidence that increasing differences in favor of the peeled stock were likely with longer storage periods.

At the Harrison Experimental Forest, exploratory trials on longleaf pulpwood were made of several chemical control methods that might prolong safe storage periods. Several fungicidal spray solutions applied immediately to peeled pulpwood gave effective control of stain and decay for the 3-month period tested so far. Any delay in applying the materials after cutting the pulpwood greatly reduced the effectiveness of most treatments. A fluoride solution which led to extensive development of a green mold on the wood surfaces gave a high measure of decay control, even though application was delayed until a week after cutting. Satisfactory control on unpeeled pulpwood stored during the summer did not appear promising with fungicidal materials alone.

Bureau of Entomology and Plant Quarantine

Pine sawfly in southern Arkansas

In May, following spring defoliation of the trees, a rough survey was made to determine the status of the pine sawfly in southern Arkansas. By and large, it appeared that defoliation was considerably less severe than in 1947. While timber operators suspected that the zone of defoliation had increased, there was some doubt in this regard since there had been no previous extensive surveys.

During June and July, small-scale studies were established near Fordyce, Arkansas, to obtain essential information on the life history of the sawfly. Cocoon collections were made and deposited within cages to obtain information on dates of emergence, adult habits, natural parasitism, and time and characteristics of egg deposition.

Observations indicate that sawfly emergence begins late in October and early in November and that egg deposition follows shortly thereafter and probably continues through most of December. Observations on small trees and on tops of large trees in cutting plots seem to indicate that a relatively small larval population may be expected in the spring of 1949. Timber operators are continuing an egg survey in cutting plots to determine more accurately the egg distribution. Results of growth studies made in cooperation with the Crossett Branch are not yet final, but there are indications that considerable loss of growth may be expected in trees heavily defoliated.

Hail damage and bark beetle attacks

In May, observation was made of bark beetle attack in timber damaged by a hail storm on April 8. Timber operators estimated that some 8,000 acres were affected by the storm. Recommendations for the prevention of the build-up of heavy beetle populations were made, and observations were continued during June and July. By the end of the summer, salvage operations were complete, and no danger from further bark beetle activities is expected. The drought of May, June, and July may have accentuated the mortality of damaged trees. On the other hand, blue stain and fungi caused much less deterioration of timber than would have occurred if rainfall had been normal or heavy.

Powder-post beetles

A large number of tests have been established on the prevention of powder-post beetle attack and the control of these insects in infested material. Treatments include a number of chemicals found effective in the past and a number of newly developed organic insecticides. There is indication that chemicals such as DDT, benzene hexachloride, Toxaphene, and chlordane might have some promise. In remedial tests, only three chemicals show signs of failing after about five months' exposure; included in these was 3 percent pentachlorophenol in #2 fuel oil. About 16 different chemicals in various formulations were used in these tests. Observations have continued on large-scale treatments of Quartermaster Corps items, particularly tool handles and dunnage, at Army posts. Treatments to date have been confined to the use of pentachlorophenol. These observations have led to a study, recently established, to determine the effect of pentachlorophenol on protective finishes and subsequent corrosion of metal parts.

Preservation--wood and wood products

Inspections were made of sections of trees impregnated with water-soluble chemicals and placed in service in 1935 and 1940. These trees were treated by sapstream methods of injection at Asheville, North Carolina. They were placed in service tests at Asheville, North Carolina; Beltsville, Maryland; Santee, South Carolina; and the Harrison Experimental Forest at Saucier, Mississippi. Very little change has taken place since the last examination. In addition, treatments established in Asheville in 1931 and 1933 were examined. Many of the test sections are still in excellent condition.

A series of lumber-dipping tests was established in Mississippi and the Canal Zone in 1946 to determine the value of various chemicals in protecting wood against termite attack. Examination of the tests after exposure of 24 months in the Canal Zone and 19 months in Mississippi has recently been made. In the Canal Zone, 1-minute, 3-minute, and 1-hour dips were largely ineffective except in the case of creosote + kerosene impregnation. Among the chemicals effective in the 12-hour treatment are creosote + kerosene, Cuprinol, copper naphthenate, and benzene hexachloride. In tests at the Harrison Experimental Forest, treatments of short duration as well as longer treatments were effective with Cuprinol and benzene hexachloride impregnations.

The testing of new building materials for their resistance to termite attack is continuing in cooperation with housing agencies and the Forest Products Laboratory. A large number of different products are now under test, both in the laboratory and in the field. Materials tested include honeycomb wall panels, wall boards of excelsior, palmetto pulp, waste paper, and other cellulose combinations impregnated with various inorganic and organic chemicals and binders. A few of the field tests have been duplicated in the Canal Zone. Results indicate that treated materials are not resistant to termites under accelerated tests, but that under less severe conditions termites tend to prefer other cellulose materials. Materials treated by manufacturers with 1 percent and 2 percent pentachlorophenol have been attacked by termites. Other treatments with sodium arsenite, 5 percent pentachlorophenol, copper naphthenate, monochloronaphthalene, and DDT have proven effective.

Panels which will serve as bearing walls have been placed in field tests as small buildings to determine the speed with which termites will attack the products under optimum conditions in service and the amount of damage which must occur before structural weakening takes place.

Ambrosia beetles

Tests were established in 1948 for the prevention of attack by ambrosia beetles on green logs and lumber. Investigations were confined almost wholly to various formulations of benzene hexachloride and methods of application because of its superiority to other new insecticides previously tested. Piperonyls were included in tests with green logs; the piperonyls and DDT were included in tests with green lumber. Tests were conducted in cooperation with four different lumber operators.

Preliminary observations of data indicate that by use of proper spray equipment satisfactory beetle control may be attained with a relatively low expenditure for handling of logs. It appears that adequate nozzles may eliminate the need for spraying individual logs. A one-man portable fog sprayer was also found to be quite effective, and it is hoped that it may eliminate the need for power equipment under certain field conditions. Benzene hexachloride continued to give highly successful results when used in dilute oil solutions, concentrates, and emulsions. Among the ineffective treatments were various formulations of the piperonyl compounds. Other newly developed chemicals which have failed to be effective in ambrosia beetle control are DDT, methoxychlor, Toxaphene, and chlordane.

Ips and borer control in pulpwood bolts

As a result of increased demand for information on the control of insects attacking wood to be used in the manufacture of various pulpwood products, small-scale tests have been established for the control of Ips and borers. Chemical treatments were applied to bolts at the time of cutting and after 1, 2, and 3 weeks of exposure. Preliminary observations indicate that materials used were much more effective in preventing attack than in controlling existing attacks;

however, good control of existing infestations has been obtained. Benzene hexachloride formulations appear more effective than DDT in all tests. Chemicals used in various formulations were DDT, chlordane, Toxaphene, benzene hexachloride, pentachlorophenol, and orthodichlorobenzene.

Subterranean termite control

Examinations were continued of soil poison stake tests established for the purpose of evaluating various chemicals for use in protection of buildings. These tests are located at Beltsville, Maryland; Saucier, Mississippi; and the Canal Zone. Because of the increasing number of new insecticides being submitted for testing, additions are being made frequently at the two former locations. Tests in the Canal Zone and in Beltsville are now 5 years old. Recent examinations indicate that sodium arsenite treatments are almost 100 percent effective at this time; they are the only ones remaining intact in the Canal Zone. DDT shows considerable promise in tests at Beltsville and Saucier, but only when used in oil solutions. After 2 years of exposure in the Canal Zone and Saucier, Mississippi, benzene hexachloride shows considerable promise.

A large number of chemicals have also been established in what is referred to as a platform test; these are designed to test the value of light surface applications of soil poisons in protecting materials under temporary storage, such as tent platforms, army storage dumps, etc. In the Canal Zone, sodium arsenite in a 10 percent solution is still effective after 2 years in dosages of 1/2, 1, and 2 pints per square foot. It is the most effective treatment used in the Canal Zone. At Saucier, Mississippi, this same chemical at half the above dosages likewise remains effective. Five percent DDT also appears effective at this location.

PLANS FOR 1949

FOREST MANAGEMENT
(Including Forest Influences)

General

Revision of Technical Bulletin 492, "Artificial Reforestation in the Southern Pine Region," now in first draft, will be completed. This is a major manuscript of approximately 1,000 pages.

A working model of the "tree meter" will be constructed and tested, with a view toward possible manufacture.

Alexandria

Establishment of pine plantations.--Studies of methods required to stimulate early height growth of planted longleaf pine are to be installed. Site preparation, spraying for brown-spot control, and fertilizing will be tested.

The study of direct seeding is being continued by a repeat test of several site preparations. Results of a 300-acre seeding trial by airplane on the Kisatchie National Forest will be studied.

Management of pine plantations.--A project analysis is to be completed. Cutting will be completed early in 1949 in a study of thinning in 14-year-old slash pine planted at four different spacings. A pruning study will be started in longleaf pine plantations.

Experimental forest.--Establishment of an experimental forest will be completed.

Birmingham

Improvement of depleted stands.--Stand improvement cutting data will be analyzed and reported early in 1949. Additional data on pine seed production and dissemination will be collected next fall.

In a study of the conversion of low-grade hardwood stands to desirable stocking, 1948 plantings will be released 1 year after establishment. Additional plots will be established.

Management of well-stocked stands.--A study of thinnings in young, well-stocked pine stands is to be undertaken on the Flat Top Experimental Forest.

Forest management alternatives.--Plans will be prepared and preliminary field work undertaken for studies to determine product, tree size, and stand density alternatives and to compare Virginia pine with mixed loblolly-shortleaf pine-hardwood stands on a short rotation in which mine props will be the principal product.

Management of the Flat Top Experimental Forest.--A plantation of about 5 acres of slash pine will be established. Improvement cutting will be continued, removing both sawlogs and mine-prop material.

Brewton

Management alternatives for longleaf pine.--The cutting scheduled for 1948 will be completed and the data on logging operations will be summarized.

Regeneration of longleaf pine.--A study of the effect of time of scrub oak removal on the development of longleaf pine regeneration is planned.

The installation of a study of the effect of longleaf pine seed trees and forest walls on the development of seedlings is to be completed.

Poisoning scrub oak.--It is planned to assist a private company in evaluating the results on several hundred acres of scrub oak poisoned with Ammate. The Cornell poisoning tool was used on most of the work, but check areas were treated by the cup-and-crystal method. A comparison of the results of the two methods will be made.

Intermediate management of longleaf pine.--The reexamination of the Loxley thinning plots will be undertaken in 1949 and a progress report prepared. This information will be part of that used in preparation of an analysis of the intermediate management of longleaf pine.

Management of the Escambia Experimental Forest.--Three compartments will be designated as "natural areas" in which no cutting will be done. A management plan (including a development plan) will be prepared.

Crossett

Comparison of management systems.--Comparisons of volume growth, quality growth, cost of logging, reproduction, control of hardwoods, and mortality are under way in the large-scale test of three silvicultural systems--selection, group, and seed-tree. Each treatment is being tested on a 60-year sawlog rotation and a 30-year pulpwood rotation. During 1949, two 30-year rotation compartments will be set up and cut under each of the systems. A study of the effect of size and condition of crown upon seed production will be undertaken on the seed-tree areas of this study to supply information that will permit the consistent selection of good seed-bearing trees.

Details of selective management.--A detailed report on 10-year results of the cutting cycle study in progress on the Crossett Experimental Forest will be completed and one or more articles prepared. During the year, a survey of the amount of effective growing space occupied by hardwoods, pine reproduction, and pine trees, and the amount of space that is unoccupied will be made on at least a portion of the cutting cycle compartments.

Natural reproduction.--To determine the effect of competition for moisture, light, and nutrients upon the survival and growth of pine seedlings, a controlled competition study will be established. By watering, trenching, and tying back or removing competitors, it is hoped to isolate some of the factors causing slow growth and mortality of young pine reproduction.

Control and management of upland hardwoods.--In order to determine if the better individuals of the better species of upland hardwoods can and should be grown on upland pine sites, a study of hardwood growth and yield will be installed in 1949. An attempt will be made to grow hardwood both in pure stands and in conjunction with pine.

In instances where a good pine understory is present, girdling instead of poisoning the overtopping hardwoods is all that is necessary to return the area to pine. There still remains the question of what time of year girdling is most effective, and a study of this will be undertaken. The effect which removing various portions of the hardwood overstory has upon pine development and growth will continue to be studied, as will the effectiveness of girdling vs. poisoning in removing unwanted low-grade hardwoods from shortleaf-loblolly pine stands.

Management of young pine stands.--A study of the effect of various thinning methods upon the quality and quantity of growth in natural even-aged stands and even-aged groups in all-aged stands will be started during the year. Data will be sought on the effect of thinning from above and thinning from below upon quality of the final products, effect of early and late thinnings upon total production, and effect of stand density on production. Progress reports will be completed for the Castor, Mayes, Arnold, Nelson, and Isom Strange thinning studies.

Pine sawfly.--Work on the study of growth loss in trees damaged by the pine sawfly will be continued and a report prepared. Additional trees may be selected for study following the 1949 spring defoliation period.

Delta

Cottonwood planting.--A project analysis to summarize progress to date and guide future work will be completed. Further tests of chemical and mechanical weeding will be made, for the cost of reducing competition of weeds, vines, and other trees is still the major item in the total cost of establishing a cottonwood plantation. Tests of cuttings held in cold storage until well into the growing season, production of nursery-grown cuttings, site preparation before planting, and the salvage of weak and poorly formed trees will be continued. Thinnings will be started in the closer spacings of 6- and 7-year-old plantations that were established to determine the best spacing.

Management of depleted stands.--The project analysis will be completed. Working plans and establishment reports will be written for the first three permanent sample plots. Further commercial improvement cutting studies will be planned, with emphasis on economic aspects and more efficient methods of logging. Tree poisoning tests established in the past 3 years will be reexamined to note any changes in effectiveness that may develop.

Growth and development of well-stocked stands.--The project analysis will be completed, together with a working plan and an establishment report for the first study.

Silvical characteristics of bottomland species.--A project analysis will be prepared. It will review the meager literature on the subject and compile information obtained from foresters and woodsmen who have had considerable experience in the Delta. Studies will be started on the first phases of the project.

Management of commercial stands.--Further work will be done in the three cooperative case studies already in progress. This involves completing the establishment of study and demonstration plots; analyzing cruise and logging data; preparing management plans; and assisting in starting, supervising, and "trouble-shooting" the planned cuttings.

East Texas

Improvement of depleted pine-hardwood stands.--Hardwood on the improvement cutting study plots will be examined early in 1949 to determine the rate of mortality and sprouting as indications of the effectiveness of the treatments. A reproduction check will be made in the early summer.

Management of commercial pine stands.--It is planned that at least one block of the study area will be cut. A progress report on the 10-year results of growth and mortality on the individual-tree study will be prepared. A work plan will be prepared and plots established to study the ecological aspects of different silvicultural cutting systems. In cooperation with the Soil Conservation Service, study plots will be established for a "D + 6" thinning study.

Management of bottomland hardwoods.--The collection of information necessary for the project analysis will be continued, and the initial treatments installed on the methods-of-cutting plots.

Use of fire in management of loblolly-shortleaf pine-hardwoods type.--The project analysis will be started. In cooperation with the Texas National Forests, burning will be conducted on three seasonal schedules set up for the Sam Houston brush control study. Fire behavior and results of different intensities of fire will be observed and a photographic record made.

Gulfcoast

Management of commercial longleaf-slash pine stands.--Cutting will be completed on all 18 compartments of the McNeill management study, and the results will be reported. A work plan for the Harrison Experimental Forest management study will be prepared.

Effect of fire in the longleaf type.--The revision of the project analysis will be completed and new studies recommended.

Regeneration of longleaf pine.--New studies are to be started on the nutrition of longleaf pine, the effects of growth regulators on longleaf height growth, and the life history of longleaf seedlings. The field follow-up and nursery phases of the Ashe Nursery study will be continued. Nursery and field installations of a geographic strain study are to be made. Installation of a seed study is to be completed. Field work is to be continued on the germination and growth of longleaf pine sown on soil treated with fire and covered with wood ashes. A reconnaissance is to be made of 1947 and 1948 plantations to determine those suitable for study of the stimulation of height growth.

Reports are to be prepared on the sawdust compost phase of the nutrition study, the exploratory phase of the seed study, the Ashe Nursery problem, the seed-tree fertilizing study, and the tree percent study. A manuscript will be prepared for Ecology on the results of the study of effect of seedbed preparation on tree percent.

Notes on a December 1948 examination of the Dry Prong burning study will be summarized and used in a manuscript for the Journal of Forestry.

Results of soil analyses made in a study of the effects of fire on longleaf regeneration will be reported.

Management of experimental forests.--The growth and mortality study plots on the Harrison Experimental Forest will be remeasured and the mortality phase reported. On the McNeill Experimental Forest, improvement and release cuttings will be made in branch bottoms and upland areas (outside of natural areas and the large-scale management study).

Ozark

Management of eastern redcedar.--Stand and yield tables are to be completed and a manuscript prepared for an Occasional Paper. Reproduction following different cutting practices in redcedar will be studied.

Thinning of hardwood stands.--The growth and development of oak crop trees released in 1934 are to be studied and reported, and the amount of sprouting on trees treated with Ammate crystals in June 1948 is to be determined.

Management of upland hardwoods.--A study of growth in relation to stand structure in white oak saw-timber stands will be organized and started.

Management of experimental forests.--An improvement cut is to be made on the Sylamore Experimental Forest in cooperation with the Ozark National Forest, and a timber stand improvement program will be instituted.

Tallahatchie

Stabilization of gullies and bare land.--Seasonal observations of grass and legume test plantings will be continued. Seeds will be gathered from plots where enough have matured to make collection practical, and plant specimens will be collected.

A manuscript on erosion control plantings in north central Mississippi and western Tennessee is to be prepared for publication.

Rehabilitation of forest soils.--A working plan to study plant succession on abandoned lands is to be revised and the study installed. The collection and identification of plants is to be continued.

A comparison of important characteristics of the principal soils of north central Mississippi and western Tennessee is to be made. Some soil factors under 12-year-old loblolly and shortleaf pine plantations and adjacent grasslands will also be compared.

Improvement of depleted hardwood stands.--Detailed Forest Survey information for north Mississippi will be analyzed to determine the most important problems in depleted hardwood stands and the measures needed for improvement.

Underplanted pine stands with the overstory trees treated with Ammate or by girdling will be examined to determine the effect of treatment, rate of kill, sprouting, and the damage to underplanted pine. Underplanted pines will be measured to determine their response to release. Low-grade upland hardwood stands will be underplanted with conifers to determine the most suitable species for underplanting.

A test of underplanting with both hardwoods and loblolly pine on fair-to-good sites will be established. Preliminary to a test of the spacing and management of underplanted eastern redcedar, a suitable area of upland hardwood will be located and prepared for planting in 1950.

Forest establishment on abandoned lands.--A project analysis is to be completed.

Farm Forestry Research

Alabama

A working plan will be completed and field work started in a study of forest management on farm woodlands in central Alabama. The objective will be to determine the effects of forest management on the net returns from the entire farm operation; how specific factors concerning the farmer, his farm, and his woodland affect forestry practice and net returns from forestry; and the extent to which forestry can and should contribute to the entire farm enterprise and total farm income. The first case study will be started at the Piedmont Substation farm of the Alabama Agricultural Experiment Station.

Mississippi

An office report on the study of the factors affecting the survival and growth of forest plantations in north central and northeastern Mississippi will be completed, together with several articles presenting the main results. Final decision has not yet been made as to the nature and objective of the new project to be started in 1949, but it will be directed toward solving specific problems of farm forestry.

FOREST ECONOMICS

Forest Resources

Analysis of forest situation.--Statistics on forest areas, timber volumes, growth, and drain for the State of Mississippi will be published as a Forest Survey Release. Included in this release will be tables comparing the current forest situation with that of 1932-35, when the first Forest Survey of Mississippi was made.

A comprehensive report on Mississippi's forests and forest industries, analyzing the data gathered on the Forest Survey, will be written and sent out for review.

An analysis of the size and quality of trees cut and the proportion of stands removed in different types of logging operations in Mississippi will be published as a Forest Survey Release.

With Forest Survey field work, on both inventory and drain phases, to be finished in Arkansas early in 1950 and in Tennessee at the end of that year, intensive preparations will be made in 1949 for undertaking the comprehensive reports on these States. Special field studies will be begun--possibly of forest landownership and management in one or both of the States--as a further extension of work completed in Mississippi in 1948.

Timber resources of Tennessee and Arkansas.--The Southern Forest Survey's initial field inventory of forest areas, timber volumes, and growth will be continued in Tennessee until the end of March. By that time, about 54 counties in western and central Tennessee will be covered; these counties contain well over half of the State's forest land. The statistics will be published in one or more Forest Survey Releases.

The Tennessee survey is being made with money appropriated specifically for work in areas not previously surveyed. The current year's funds will not permit completion of the survey of the entire State. Work will thus have to be interrupted until early 1950 and will not be finished until late fall of that year. The interim will be spent in resurveying the major portion of Arkansas (the entire State outside the Ozark counties), which was covered previously in 1935 and 1936.

Land use in southwest Louisiana.--In collaboration with Range Research, extensive revisions were made in a report on the 1946 study of pine planting and cattle grazing as profitable integrated uses of cut-over longleaf pine land. In 1949 the manuscript will be submitted for publication.

At the Alexandria Branch, a study will be started of the economics of rehabilitating cut-over, nonrestocking forest land. Possibilities in both timber management and grazing will be investigated.

Forest-economic statistics.--An atlas of current high-light data on the forest resources of the South, compiled during 1948, will be released jointly by the Southern and Southeastern Forest Experiment Stations.

Forest Survey techniques.--Toward improving the coverage and accuracy of the Forest Survey, two studies of inventory methods will be started.

Tests will be run to determine the possibilities of more intensive use of Production and Marketing Administration aerial photographs.

A study will be started to develop better guides to the estimation of cull in standing timber. At the end of about 6 months, results will be analyzed to determine the profitability of further work. If these early indications are favorable, the study will probably be pointed toward preparation of a brief handbook that will aid the timber cruiser in interpreting the various external cull indicators (as butt scars, holes, broken tops) in terms of cull in the various tree species. The findings are intended primarily for Forest Survey use, but will be of general value in cruising and appraising timber.

Economics of Forest Management

Guides to profitable forest management.--The over-all project plan, including a fully annotated bibliography on the evaluation of forest management alternatives, will be finished.

Manuscripts on the two studies begun but not completed in 1948--guides to profitable tree utilization and the best size of tree to grow for southern pine lumber--will be submitted for publication.

Three new studies will be started. If preliminary exploration reveals that the data needed are available, these studies will be: (1) the most profitable size of tree to grow for pulpwood--a study parallel to that now under way for lumber; (2) optimum growing stock in selection forests, taking loblolly-shortleaf pine-hardwood stands in south Arkansas as an example; (3) optimum growing stock in even-aged stands.

Loblolly-shortleaf timber-management rules for farmers.--After review by State and Extension foresters in the region to which it applies, the manuscript on farm forestry will be revised and submitted for publication as a U. S. Department of Agriculture Farmers' Bulletin.

Returns from well-managed commercial forests.--A progress report covering 10 years of selective management under 3-, 6-, and 9-year cutting cycles at Crossett, Arkansas, will be completed and published in 1949.

At Brewton, Alabama, the first cut will be made on the 640 acres of second-growth longleaf pine which is being managed as an investment forest. The results will be published.

Returns from well-managed small tracts.--Studies of the financial possibilities of small woodlands will be continued at six branch stations during 1949. At most of these branches, field days will be held on the experimental forests in order to show farmers what products can be cut annually when intensive management is practiced. Records of costs and returns will be given out and methods of managing and harvesting timber will be demonstrated to farmers on the ground.

In these studies at the branches, only the best management practices are applied. The purpose is to test one system, not compare alternative systems. However, as a byproduct, much valuable experience is gained leading to better management techniques. This has been especially true at Crossett, where records cover a longer period than at other branches; and an analysis of 10 years of selective cutting on the "good" and "poor" forties will be published in 1949. At the other branches involved, annual reports on these studies will be started or continued.

Forest Industry

Timber production and forest drain.--As part of the Arkansas Forest Survey, a canvass of wood-using plants and operations will be made as a basis for estimating the 1948 drain upon forest growing stock.

A survey of 1948 pulpwood production will be made for the entire Station territory and the results published as a Forest Survey Release.

A report will be released on Mississippi's forest industries and their production.

Small lumber-mill realization values.--Results of a study of a small East Texas pine sawmill will be released as an Occasional Paper. The report will analyze lumber values and production costs as related to size and grade of sawlog.

Logging methods, equipment, and costs.--More data will be collected on the costs of long-length logging, to strengthen the study begun at Crossett in 1947. These data will be taken from operations specially equipped and manned for this type of logging.

The Crossett Branch will also undertake a study of current logging and pulpwood production operations in its territory, so as to follow recent changes in methods and equipment and draw cost comparisons between 1949 and 1940.

Marketing and Prices

In the territory of the Birmingham Branch, mines and other wood users offer highly diversified outlets for timber, and as a result the forest is heavily depleted. Studies will be begun to help discover how the territory's excellent markets can be used in the interest of good forest management. The first of these studies, to be made in 1949, will be a survey of wood users to determine their requirements for the various grades of pine and hardwood logs and bolts. Later studies will compare these requirements with the inventory of available standing timber, estimate the types of use of standing timber that will favor good forest management, and investigate specific possibilities for promoting these types of use.

RANGE RESEARCH

Alexandria

Grazing management.--Results of the Louisiana forage study are now in review draft. The manuscript will be revised and submitted for publication as a bulletin of the Louisiana Agricultural Experiment Station.

The manuscript for the booklet on identification of important forage plants will be completed.

The study of the methods of measuring forage will be continued another year because both the 1947 and 1948 growing seasons were drier than usual. Production data from a more normal season are needed.

Observations of herbage changes under five degrees of hardwood control on land planted to pine will be continued. A progress report will be prepared.

Supplemental feeding of cattle will continue during the winter of 1948-49. The cattle weights and calf records will be followed through to October 1949, at which time the study will be closed and a final report written.

Results of preliminary studies of hogs on forest range will be written up for publication. As it appears doubtful that the proposed experimental forest will be fenced in 1949, further hog study will be delayed until 1950.

Control of low-value hardwoods.--Results of the past 4 years' work on poisoning undesirable upland hardwoods will be published in professional journals and an Occasional Paper. Instructions for poisoning low-value hardwoods will be revised. Tests of promising new chemicals and methods will continue on a limited scale.

Artificial revegetation.--Results of 3 years' exploratory tests of forest range seeding and fertilizing will be summarized in an office report and prepared for publication in a professional journal. A working plan will be written for the firebreak study. A firebreak demonstration test will be established in cooperation with the Industrial Lumber Company of Elizabeth, Louisiana.

Brewton

Grazing management.--The project analysis will be revised for publication as a Station release. A working plan will be prepared and field measurements made in a study to evaluate the kind, amount, and value of range forage resulting from various silvicultural treatments and forest management systems in second-growth longleaf and slash pine.

A new study is planned in the economics of forest range management; it will consist of case studies of a few typical cattle operations.

Artificial revegetation.--Results will be recorded of seeding and fertilizing tests made in 1948 on the firebreak study.

East Texas

Grazing management.--An exploratory study is planned of the present status of forest grazing in East Texas. The study will be supplemented by case histories, and will provide a background for later work.

Gulfcoast

Grazing management.--Estimates of forage production and chemical analyses of forage samples will be continued and written up for publication. Initiation of actual cattle grazing on the McNeill Experimental Forest is planned for March 1950. Unless funds for pasture fences are made available, however, the work will necessarily be on a very extensive basis.

An office report will be completed on the sheep damage study, and a manuscript submitted for publication.

Artificial revegetation.--Collaboration will continue with the Bureau of Plant Industry, Soils, and Agricultural Engineering on selection of species adapted to southern forest range conditions.

Ozark

Grazing management.--The project analysis will be completed. Field measurements will be made of forage production on upland hardwood forests under various conditions at the peak of development in August. Three years' results on Ozark forest range forage will be submitted for publication in a professional journal. The deer forage utilization study will be continued on a maintenance basis.

A working plan will be prepared for a new study on the effect of grazing on hardwood stand establishment and development.

FOREST UTILIZATION SERVICE

The work on waste will be continued and, if possible, extended to cover hardwood species. Further tests of the performance of gas kilns will be made. The veneer and plywood industry, which has been expanding in this region for several years, will be given special attention.

Activities designed to develop a satisfactory classification system for round forest products will be continued in connection with the East Texas Branch study of the utilization of inferior hardwoods, marketing studies of the Birmingham Branch, and milling studies to be carried on by the TVA. If supplies of wood molasses are available, arrangements will be made for further test of its utility as a livestock feed. Interest will be maintained in the preservation field and problems of seasoning, including kiln-drying refractory species.

As in the past, general assistance will be extended to both public and private concerns, with emphasis wherever possible on the "wholesaling" approach offered by extension groups. The development of local research programs will be closely followed in order that maximum coordination between the local programs and those of the Forest Products Laboratory may be achieved.

FLOOD CONTROL SURVEYS

High priority jobs for the coming year are: (1) to complete the upper White River survey report and expedite regional review by Federal and State agencies, (2) to complete field work and data analysis for the Homochitto-Buffalo River survey by July 1 and the report itself by early fall, and (3) to complete the advance planning and start a survey of the Ouachita River basin (Arkansas and Louisiana).

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1948

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TWENTY-NINTH ANNUAL REPORT

1949

SOUTHERN FOREST EXPERIMENT STATION
Chas. A. Connaughton, Director
New Orleans, La.

(OAKLAND-12-18-47-5.000)

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TWENTY-NINTH ANNUAL REPORT

SOUTHERN FOREST EXPERIMENT STATION

1949

Results of research by the Southern Forest Experiment Station are reported regularly in various publications. In 1949, 74 papers were published. In addition, brief reports of current interest were released by the Station at bimonthly intervals in Southern Forestry Notes. Regular review of these Notes, together with review of current publications, provides the opportunity to keep informed of the results of studies in progress.

It is not possible, however, in the Notes or other publications to report all results, particularly those from incomplete studies on which work is continuing. For this reason, a report is prepared annually which briefly summarizes results obtained during the calendar year, with emphasis on information not covered in previous publications. This is the twenty-ninth annual report for the Southern Station. In addition to presenting results of 1949, it outlines briefly the plans for 1950. A list of publications released during the year is included also.

RESULTS

FOREST MANAGEMENT
(Including Forest Influences)

Regeneration

Geographic source of loblolly pine seed

Measurement of loblolly pine plantations at Bogalusa, Louisiana, shows clearly the benefits of using seed from local sources, at least for loblolly pine. Briefly, trees from seed secured locally yielded 2.7 times as much pulpwood at 22 years as trees from an Arkansas seed source. Seed from Texas and Georgia was little better than Arkansas seed for Louisiana plantations (table 1).

Table 1.--Effect of seed source on growth of a 22-year-old loblolly pine plantation at Bogalusa, La. (mean annual temperature 68°F., 255 days frost-free)

Geographic source Mean annual temperature; average frost-free period; distance from planting site	Survival	Average height	Average d.b.h.	Merchantable rough pulpwood per acre	Living trees with fusiform rust on trunks
	Percent	Feet	Inches	Cords	Percent
Livingston Parish, Louisiana 68°F.; 260 days; 50 miles	82	46	6.7	41.8	4
Montgomery County, Texas 69°F.; 265 days; 350 miles	83	41	5.2	22.7	6
Clarke County, Georgia 61°F.; 200 days; 450 miles	77	38	5.2	17.7	37
Howard County, Arkansas 60°F.; 220 days; 350 miles	84	36	4.7	15.4	5

In view of the big tree-planting program now under way in the South and getting bigger every day, the results of this study are unusually important. In practical terms, at Bogalusa, if 40,000 acres had been seeded with Georgia or Arkansas seed instead of Louisiana seed in 1926-27, the resulting decrease in potential yield of pulpwood by 1950 would have been equivalent to about $1 million. Furthermore, seed from at least one source (Georgia) appeared to be particularly susceptible to fusiform rust in Louisiana. At least until more research is done, local seed should certainly be used in planting loblolly pine.

Parent trees

In south Mississippi, seedlings in nursery beds 35 days after sowing showed a range of 7 to 77 percent in survival for 24 individual longleaf pine parent trees. No strong relationship between external characteristics of mother tree or cone and seed quality has been found as yet, but it appears fairly certain that seed from some trees tends to be superior in quality.

Sun-drying slash pine seed before storage

For storage of several years, southern pine seed must be dried to about 9 percent moisture content and kept at 41°F. or lower. Where better facilities are lacking, a practical method of preparing slash pine seed with an unknown but probably high moisture content for cold storage over winter is to dry the seed in shallow layers in the sun for 3 days before storing it. The results in table 2 from tests during 1949 show similar benefits from sun-drying seed which, for one or another reason, must be kept for a year at ordinary room temperature instead of in cold storage.

Table 2.--Germination of slash pine seed following various methods of drying, cleaning, and storing

Method of seed cleaning; condition of seed before experimental drying	Germination after 1 year's storage			
	At 38° F.		At room temperature	
	Seed dried 3 days in sun	Seed dried 1 day in shade	Seed dried 3 days in sun	Seed dried 1 day in shade
	Percent			
Fanning; seed moderately moist	68	77	41	16
Flotation; seed very moist	80	79	50	0

Nursery practice

First-year examination of plantings of longleaf seedlings from the Ashe Nursery showed that longleaf trees from fall-sown seeds were definitely superior to spring-sown longleaf, probably because fall-sown longleaf was virtually free of root rot. Considerable variation in survival and amount of root rot was found between species (table 3).

Table 3.--Comparative health of Ashe Nursery stock by species and first-year success in the field, Leaf River Ranger District, DeSoto National Forest

Species	Proportion of all nursery stock rated healthy[1] at time of lifting	Proportion of planted trees rated satisfactory[2] after first year in the field
	- - - - - Percent - - - - -	
Loblolly pine, spring-sown	48.6	90.8
Slash pine, spring-sown	68.7	83.9
Longleaf pine, fall-sown	98.3	75.6
Longleaf pine, spring-sown	35.7	63.3

---

[1] Determined from laboratory samples, January 1948. May include some light infection not noticeable to graders.

[2] Determined in field, January 1949. Essentially equivalent to surviving seedlings less those obviously doomed.

Of the three pines, longleaf appeared to be most sensitive in the field to root-rot effects, but fall sowing of longleaf gave satisfactory control of root rot. Even with healthy stock, longleaf tends to rank a poor third in field survival, emphasizing the need for finding ways of growing high-quality longleaf pine seedlings.

In all tests where sawdust was added to the longleaf nursery beds, the resulting outplanted seedlings survived better than where no sawdust was added. Eighty percent of the fall-sown seedlings from beds where sawdust was used showed fair or better vigor at the end of the first season in the field, as against 76 percent from nursery beds with no sawdust. Similarly, spring-sown seedlings showed 68 percent survival compared to 53 percent. The main effect of sawdust on spring-sown longleaf survival probably stems from reduction in amount of root rot.

The use of sawdust in the seed beds also reduced the prevalence of root rot on slash and loblolly seedlings. The treated beds produced 20 percent more healthy trees than the checks. In the 1947-48 field tests, however, slash pine from sawdust treatments grew less than 80 percent as well as seedlings from untreated checks, which suggested a depressing effect from nutrient deficiency in the nursery beds. In the 1948-49 field tests, slash pine from beds receiving about the same amount of sawdust as in the previous year but with greater mineral supplements grew 13 percent better than the check seedlings, indicating that growth depression had been averted by fertilizing.

That the field survival of seedlings is influenced by the nursery which produces them is strikingly illustrated in outplanting results from a study of the effect of seed source on longleaf height growth. Seedlings were taken from two nurseries--one in Alabama and one in south Mississippi. Although only preliminary results are available, and only from outplantings in Mississippi, the superiority of stock from the Alabama nursery is clearly shown (table 4).

Table 4.--Proportion of longleaf seedlings in good and excellent vigor five months after planting on the Harrison Experimental Forest, June 1949

Seed source	Good and excellent vigor		Green weight per seedling		Dry weight-green weight ratio	
	Alabama nursery	Miss. nursery	Alabama nursery	Miss. nursery	Alabama nursery	Miss. nursery
	- - Percent - -		- - Grams - -		- - Ratio - -	
Alabama						
Good site	96	54	21.8	30.3	0.37	0.34
Poor site	86	43	15.1	21.3	.42	.34
Mississippi						
Good site	71	40	9.0	15.2	.39	.32
Poor site	80	47	9.5	15.7	.40	.33
Average	83	46	13.8	20.6	.40	.33

Regardless of seed source, the Mississippi nursery produced bigger seedlings than the Alabama nursery. In contrast, however, the percentage of seedlings of good and excellent vigor was almost twice as good in the Alabama nursery. A possible index of vigor may be the ratio of dry to green weight. This ratio is definitely higher in the stock coming from the Alabama nursery. The outstanding difference between seedlings from the two nurseries at the end of the first season on the Harrison Experimental Forest is the much greater number of Alabama nursery seedlings that have large pointed buds. The presence of these buds suggests height growth may start within three years of outplanting, instead of the usual five to seven years. At about the end of the first season in the field, seedlings from the Alabama nursery were definitely superior to those from the Mississippi nursery. This was true regardless of the seed source.

Direct seeding

The importance of seedbed preparation in direct seeding is shown by tests conducted over a two-year period in central Louisiana. Even in a year when a severe summer drought caused widespread failures with planted stock, longleaf and slash pine were successfully established on areas either disked or furrowed just prior to seeding in the fall. In a year of more normal rainfall, burning just before seeding also gave satisfactory results. The tree percents (trees established per 100 seeds sown) by treatments are shown in table 5.

Table 5.--Tree percents obtained in direct seeding tests in 2 successive years

Seedbed preparation	1949 test (normal year)				1948 test (dry year)			
	Longleaf		Slash		Longleaf		Slash	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Disked								
Fresh	27.8	26.5	10.5	9.5	16.4	10.6	29.4	6.5
1-year-old	3.5	3.5	4.2	3.8	...	...	...	...
Burned								
Fresh	25.0	23.0	6.0	6.0	11.2	1.1	33.2	.6
1-year-old	1.0	1.0	4.2	4.2	...	...	...	...
Plowed								
Fresh	8.2	7.9	2.3	2.3	4.8	4.1	8.7	7.0
1-year-old	.8	.8	.9	.9	...	...	...	...
Hoed spots	...	...	...	...	2.4	.4	7.4	.2
Old rough, untreated	...	...	...	...	0	0	0	0

Effective rodent control is secured by burning, plowing, or disking to remove the plant cover. In addition, disking and plowing reduced competition from grass and weeds and thus provided insurance against excessive summer mortality. In plowed furrows, seed may be washed out by heavy rains and lost, but survival and growth are exceptionally good. For example, slash pine in the furrows reached a height of 2 feet in 2 years, while longleaf pine averaged better than a half inch in diameter at the ground line. Some of the longleaf will probably start height growth in the third year. Growth of both species has been slightly less on the disked areas.

On the basis of tree percent obtained in this study, it is recommended that seed of high germination percents be sown at the rate of 15,000 per acre. This is equivalent roughly to 3 pounds of longleaf or three-fourths pound of slash pine seed. If seed of low germination percent is used, a proportionately higher seeding rate is necessary. Germination tests showed that the differences in the 2 years in tree percents between species (table 5) were due mainly to differences in germination percent of the seed used.

Airplane seeding

Direct seeding from airplanes holds promise as a practicable method of reforesting extensive areas quickly and cheaply. This was demonstrated on the Kisatchie National Forest, where 1,200 acres were seeded by airplane at a total cost of approximately $4.00 per acre. Longleaf seed was sown in November 1948, at a rate of 3 pounds per acre.

Where fresh seed of good quality was used, a satisfactory stand was obtained. At the end of the first season, one area had an average of 3,300 seedlings per acre, with 60 percent of the milacres stocked with one or more seedlings. A second area had 1,460 trees per acre, with 40 percent stocking; and a third had 1,520 trees, with 52 percent stocking. At one location, town ants destroyed the seed and newly germinated seedlings over half the area. Part of a third location failed because the old seed which was used did not germinate satisfactorily. All areas were burned within the year before seeding, and frequently in previous years. It is believed that this frequent previous burning had effectively reduced the rodent population.

Underplanting

The second-year results of a study of underplanting scrub oak with loblolly and slash pine show that both survival and growth of the pines are greatly benefited by release--girdling or poisoning the hardwoods--immediately after planting (table 6). The study area is near Alexandria, Louisiana.

Table 6.--Two-year growth of pine planted under scrub oak

Treatment	Survival	Average total height	1949 average height growth
	Percent	Feet	Feet
		Loblolly pine	
Released immediately after planting	86	2.3	1.4
Released one year after planting	63	1.6	.7
Not released	45	1.4	.5
		Slash pine	
Released immediately after planting	46	1.8	1.1
Released one year after planting	36	1.1	.4
Not released	28	1.0	.4

This study is demonstrating that scrub oak areas can be successfully converted to pine stands by underplanting, provided the pines are released soon after or perhaps just before planting. Although the cost of establishment is more than on open sites, the excellent survival obtained may partly compensate for the greater cost. A severe and prolonged summer drought prevailed during the first growing season, and plantations on open grass sites were practically total failures, while released plantings in scrub oak stands were successful.

Released areas were more heavily grazed by cattle, and tipmoth infestation was more than three times as great as where there was no release. Despite these adverse influences, a better stand of pine is developing on the released area.

In north Mississippi, low-grade upland hardwood stands on a ridge and upper slope were underplanted with several species of conifers. Species used were loblolly, shortleaf, longleaf, slash, and Virginia pine, and eastern redcedar. Following planting, half the plots were released by girdling or poisoning the undesirable stems in the overstory. First-year survival counts show that loblolly pine survived best, 89 percent. Next came redcedar, 87 percent; Virginia pine, 82 percent; shortleaf pine, 77 percent; slash pine, 51 percent; and longleaf pine, 46 percent. The average survival of all species except redcedar, which was the same in each case, was 7 percent greater on the released plots. A survey has shown that there are 220,000 acres of such stands in north central Mississippi which require reinforcement planting.

Also in north Mississippi, five high-value hardwood species (white oak, white ash, yellow-poplar, black walnut, and black locust) and loblolly pine were underplanted in low-grade hardwood stands on upper, middle, and lower slopes and on minor bottoms. Before planting was begun, half of the plots were released by girdling or poisoning undesirable hardwoods. An average of 94 percent of all planted seedlings survived the first growing season, with the survival averaging 3 percent greater on the released plots. Average survival was 95 percent on upper and middle slopes, 92 percent on lower slopes, and 90 percent on minor bottoms. Best survival was with yellow-poplar, 100 percent; followed by white ash and black walnut, 99 percent; loblolly pine, 93 percent; white oak, 92 percent; and black locust, 87 percent.

Near Birmingham, Alabama, in February 1948, loblolly pine was planted at a spacing of 6 by 7 feet under an overstory of inferior hardwoods. A portion of the planted area was then treated by (1) removing all undesirable stems 1.6 inches d.b.h. and over (2-inch class) and (2) by removing all undesirable stems that could pay their own way commercially. Both treatments were repeated one year later on another portion of the plantation. Untreated check plots are maintained for comparison.

Two growing seasons after establishment, the plots which received immediate release showed superior survival and height (table 7). Check plots showed slightly poorer height growth than the delayed treatments, but survival on these untreated plots was better than that found on any other treatment. Lower survival on the treated plots is largely due to logging damage.

Table 7.--Survival and height growth of loblolly pine two years after underplanting

Treatment	Survival	Average total height	Average 1949 growth
	Percent	- - - Feet	- - -
Release to 2-inch diameter			
Immediate	75	2.0	0.9
Delayed 1 year	66	1.3	.5
Commercial release			
Immediate	73	1.8	.9
Delayed 1 year	64	1.2	.4
Check plots	79	1.1	.4

Two years after planting and release, survival of yellow-poplar was excellent (90 percent or better) in all treatments. Total height averaged about 1 foot on areas without release; 2.3 feet where only commercial-sized trees were removed; and 3.4 feet where all competing trees as small as 2 inches d.b.h. were cut.

Trees on the check and 2-inch diameter release plots were classified by topographic situation. Measurement of height growth in relation to position on the slope shows the advisability of confining the planting of yellow-poplar to the bottoms and lower slopes to which it is best suited. Growth on the upper slopes and ridges was only about one-third of that on the bottoms and lower slopes.

Machine planting

Machine planting has expanded more rapidly than our knowledge of its effect on survival and growth of seedlings. The consensus is that if machine planting is satisfactory for longleaf pine, it should certainly yield as good or better results with other southern pines. Accordingly, the Mississippi National Forests have installed tests on the Chickasawhay Ranger District to determine how well machine planting of longleaf pine compares with the standard bar method. Results after 3 years are now available for one area and after 2 years for another (table 8). Although hand planting resulted in better survival, the difference is small and is offset by greater numbers of living seedlings per row in machine planting.

Table 8.--Performance of longleaf pine planted by Lowther machine in contrast to bar planting

Date and method of planting	Survival		Average spacing of survivors per row	
	Dec.1948	Dec.1949	Dec.1948	Dec.1949
	- - Percent - -		- - Feet - -	
March 1947				
Machine	62	59	7.3	7.8
Bar	70	70	10.0	10.0
January 1948				
Machine	57	54	8.4	8.9
Bar	60	57	9.4	9.7

A test was also installed on the Leaf River Ranger District in Mississippi to determine whether size of longleaf seedling has any material effect on quality of machine planting (table 9).

Table 9.--Comparison of large, medium, and small longleaf pine seedlings planted by machine, January 1949

Item	Size of seedlings[1]		
	Large	Medium	Small
	- - - Grams - - -		
Average green weight at planting time	27.4	12.8	6.4
	- - Percent - -		
Planted too high	41	33	25
Planted too deep	3	8	14
Planted right	56	59	61
Total	100	100	100
Survival, December 1949	82	88	90
Killed by hogs	15	7	5

[1] 600 seedlings of each size.

Even though the planters were experienced men, there was a tendency to plant large seedlings too shallow and small seedlings too deep. There was not much difference in the proportion of properly planted seedlings between size classes. Hogs that got into the fenced pasture showed a preference for large seedlings. Even among the small- and medium-sized seedlings, they confined their feeding to the larger specimens. The differences in survival are not important, because a greater proportion of the large seedlings than of the small and medium seedlings are of excellent vigor at the end of the first season. Barring hogs, wildfires, and other disturbing elements, a much greater number of the larger seedlings should start early height growth.

Hybrid pine planting

During 1948, a few seed from loblolly-shortleaf pine hybrids back-crossed to each parent were available for testing. Seedlings from these seed were outplanted in northern Alabama and Mississippi. A comparison of the growth of the hybrids with that of native trees did not yield conclusive results at the end of the first season. However, these hybrid trees will be observed with interest in the future.

Baldcypress planting

The small January 1948 planting of baldcypress wildlings, made in cooperation with the Joseph Rathborne Land Company near Choctaw, Louisiana, was reexamined after its second growing season. Wildlings that were 1 year old and at least 30 inches over-all (top plus plantable root) when planted showed 86 percent survival and an average height growth of 13 inches both in 1948 and 1949. Wildlings less than 30 inches long when planted showed only 25 percent survival. Height growth for all surviving seedlings was surprisingly erratic; a few showed consistently good or poor growth, apparently because of variable damage to the tops by a common twig gall. Height growth of individual seedlings in 1948 ranged from 5 to 20 inches, and in 1949 the range was from 3 to 26 inches.

All of the wildlings that were 2 years old when planted are still alive. They grew 1 to 20 inches in 1949; the average was only 7 inches. Despite considerable damage by twig galls, these trees still seemed vigorous.

In January and February 1949, additional plantings were made, mostly of 1-year-old seedlings grown in a nursery at Southwestern Louisiana Institute. At the end of their first growing season in a cut-over swamp, nursery 1-year-olds that were at least 30 inches long over-all when planted showed 98 percent survival and averaged 13 inches of height growth in 1949. Smaller nursery 1-year-olds showed 92 percent survival but an average of only 9 inches of height growth in 1949.

Seedlings less than 30 inches long over-all when planted have been under water, on the average, 34 consecutive days in 1948 and 44 consecutive days in 1949--each time just as baldcypress starts to leaf out. Seedlings 30 inches and longer over-all when planted kept their tops continuously above water, on the average, both in 1948 and 1949. In the swamps under consideration, maximum high water is usually about 24 inches, and it generally occurs in middle to late March. Baldcypress seedlings at least 30 inches long over-all are needed for satisfactory results under these conditions. Ninety percent of the one-year-old nursery seedlings produced and used in 1949 were of this size. Older seedlings are unnecessarily large, costly, and hard to handle.

Cottonwood planting

The use of mechanical cultivation for eliminating harmful weed and vine growth in first-year cottonwood plantations shows promising results in the Mississippi Delta. Planting strips at least 5 feet wide must be prepared before machines can be used. The strips must have fairly flat surfaces with no large clods. For areas with an especially dense cover of vines, a heavy fire-line plow has proven most effective, while farm disks can be used successfully for light grass or weed cover.

As in every previous test, hoe cultivation with initial fertilization proved best (table 10), but is too expensive to use in large-scale planting. Two disk cultivations between the rows, the first being made in one direction only and the second including cross cultivation, proved satisfactory and cheaper than hoeing. Two diskings between rows without cross cultivation were not satisfactory. Use of a machine which straddles the row permits working closer to the trees and produces a cultivation comparable to hand hoeing.

Table 10.--Effect of fertilization and cultivation on the establishment and first year's growth of cottonwood plantations in the Mississippi Delta

Treatment	Survival	Average height	Proportion of trees 36 inches or taller[1]
	Percent	Inches	Percent
One ounce of ammonium nitrate in 7-inch holes at planting and two hoeings	95	69	90
Two ounces of ammonium nitrate in 7-inch holes at planting and two hoeings	80	65	75
Two ounces of ammonium nitrate in 7-inch holes at planting and two diskings between rows, the second including a cross cultivation	81	56	67
Two ounces of ammonium nitrate in 7-inch holes at planting, and two diskings between rows (no cross cultivation)	78	41	47

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[1] At least 400 trees 36 inches and taller are desired at the end of the first year. This requires a first-year survival of 56 percent when spacing is 6 feet by 10 feet.

The use of a paper mulch to eliminate weed competition was tried in 1949, but proved unsuccessful and prohibitive in cost. Patches of tarred building paper and building felt 5 feet square were not large enough to keep weeds around the edges from overtopping and retarding the growth of a tree planted in a hole in the center of the square. First-year survival was unsatisfactory.

Good nursery yields of cottonwood cuttings depend on close spacing of the rootstocks and light competition from Johnson grass and weeds. With light competition and a spacing of 40 by 12 inches, 25,000 20-inch cuttings per acre per year were produced in the second and third years after establishment, 2½ times as many as from a 40 by 24-inch spacing. In places where the competition from weeds and Johnson grass was heavy, however, the production of the 40 by 12-inch spacing was only 7,000 the second year and 15,000 the third year.

Two years ago, small experimental plantings of cottonwood were made on old-field sites in a small stream bottom near Alexandria, Louisiana, and in a larger bottom--a former course of the Tallahatchie River--near Oxford, Mississippi. Five cultivation and fertilization treatments found successful in the Delta region were applied in the first year in each plantation. The Louisiana test averaged 77 percent first-year and 62 percent second-year survival. Average heights were only 15 inches after one year and 19 inches after two years. The present height and vigor of the trees are so poor that the plantation is considered a failure: the small stream bottom site evidently is not suitable for cottonwood.

The north Mississippi test averaged 97 percent first-year and 67 percent second-year survival, but average height was only 24 inches after 1 year and 27 inches after 2 years. Heavy damage from deer browsing is partly responsible for the poor height growth, and probably also for the considerable drop in survival after the first year. It is too early to say whether or not this plantation will prove successful.

The most notable differences between both of these plantations and typical Delta plantations on suitable sites are the considerable second-year mortality (which averages only one percent in the Delta) and the much poorer height growth and vigor.

Influence of spacing on growth of slash pine plantations

Remeasurements were made in a spacing study in a 14-year-old slash pine plantation on the Palustris Experimental Forest near Alexandria, Louisiana. The results (table 11) confirm that in extremely close spacings thinnings are needed at an early age. Otherwise, excessive mortality occurs. Unfortunately, commercial thinnings at an early age in such stands are not usually possible. In spacings of 2,500 trees per acre, more than 1,000 trees per acre died within 14 years--a tremendous loss that nearly equals the initial number planted in the approximately 6 by 6-foot spacing (1,150 trees per acre). Moreover, the latter spacing produced an equal cordwood volume with less than half the total number of living trees.

Table 11.--Effect of spacing on growth of planted slash pine in 14 years

Item	Initial spacing; number trees planted per acre			
	2,500	1,600	1,150	250
Total trees living, per acre	1,483	974	731	195
Survival (percent)	59	61	64	78
Basal area (sq. ft. per acre)	142	118	106	51
Average d.b.h. (inches)	4.2	4.7	5.2	6.9
Average height of dominant trees (feet)	42	42	42	41
Trees 4.6 inches and larger (number per acre)	564	512	468	183
Volume per acre (rough cords[1])	18.1	18.4	18.3	9.6

[1] Merchantable volume in trees 4.6 inches and larger, with utilization to a top of 3.5 inches in diameter, outside the bark.

With reasonably good survival, planting slash pine closer than 6 by 6-foot spacing can be recommended only for special purposes such as erosion control, or where small trees can be used profitably.

Silviculture

Stand improvement

In 1939, a study was installed at Crossett, Arkansas, on the release of young pine from overtopping hardwoods. The study area, typical of many thousand acres in southern Arkansas, was covered with small hardwoods averaging about 5 inches d.b.h. Nearly 1,200 pine seedlings per acre and a scattered stand of saplings and small poles were being suppressed. Three treatments were tested: one removed all hardwoods 6 inches d.b.h. and larger, another removed all hardwoods 2 inches d.b.h. and larger, and a third removed all hardwood 5 feet tall and over. Only trees competing with pine seedlings were removed.

Present-day costs of these treatments, based on girdling trees over 4 inches d.b.h. and cutting the smaller ones, and allowing $0.96 per hour for labor, overhead, and supervision, amount to $0.53, $1.84, and $2.43 per acre, respectively.

Pine growth and development has been excellent in the last two treatments but inadequate where only trees 6 inches d.b.h. and larger were removed (table 12).

Table 12.--Pine stand per acre in 1939 and 1949, trees 2 inches d.b.h. and larger

D.B.H. (inches)	Hardwoods 6 inches and larger removed			Hardwoods 2 inches and larger removed			Hardwoods 5 feet and taller removed		
	1939	1949	Increase 1939-1949	1939	1949	Increase 1939-1949	1939	1949	Increase 1939-1949
					Number of pines				
2	9	84	76	17	120	103	28	140	112
3	15	41	26	13	84	71	21	99	79
4	12	25	13	9	51	42	15	64	49
5	13	17	4	11	37	26	15	43	38
6	8	12	4	7	21	13	13	29	16
7+	39	75	36	34	74	40	33	78	45
Total	96	254	159	91	387	295	125	453	339

Growth of the released pines has been so rapid in the two most intensive treatments that commercial thinnings were needed and made in the fall of 1949--only 10 years after release. The lightest treatment was also thinned for purposes of comparison, but the thinning was not commercially feasible. Table 13 shows that the stumpage returns from the thinnings in both the intensive treatments have already exceeded the original treatment costs, corrected for current wage rates but without considering interest.

Table 13.--Costs per acre of release cutting and returns per acre from thinning released seedlings

Item	Hardwoods 6 inches and larger removed	Hardwoods 2 inches and larger removed	Hardwoods 5 feet and taller removed
Treatment cost	$0.53	$1.84	$2.43
Volume per acre thinned in 1949 (cords)	.19	1.51	1.62
Stumpage value of pine removed in thinning	$0.38	$3.02	$3.24
Returns from thinning less treatment costs	-$0.15	$1.18	$0.81

The most intensive hardwood removal resulted in the best stand of pine, but it is doubtful if the added cost will be justified by the returns. It is recommended that where adequate pine reproduction is present and the overtopping hardwoods are relatively small, all inferior hardwoods down to 2 to 14 inches d.b.h. be girdled or cut. Any smaller hardwoods directly overtopping pine should also be cut and perhaps poisoned.

Annual measurements of 138 seedlings ranging from 0.6 to 7.0 feet tall at the time of release indicate that small hardwoods and sprouts may resuppress many released seedlings initially under 3 feet tall. Seedlings over 3 feet tall are rarely resuppressed. Hence, it appears that poisoning small undesirable hardwoods with Ammate to reduce sprouting is desirable where the pine understory is below 3 feet in height.

In another study in southern Arkansas, the low-grade hardwoods on a 40-acre tract containing good reproduction of loblolly and shortleaf pines were girdled in August 1947. Species treated included sweetgum, southern red oak, blackgum, and several species of hickory and elm. Diameters of the treated trees ranged from 4 to 29 inches and averaged 7 inches.

For all species the percent of trees sprouting decreased sharply with increases in tree diameter (table 14). In general, the percent of trees with some live crown increased as tree diameter increased. Red oak crowns died most rapidly. Most of the trees with part of their crowns still alive had not sprouted. Twenty-one months after treatment, dominant sprouts averaged 3 feet high for most species and diameter classes.

Table 14.--Sprouting and crown kill of various girdled hardwoods, 21 months after treatment

Species	4-6-inch trees		7-9-inch trees		10+-inch trees	
	With sprouts	With live crowns	With sprouts	With live crowns	With sprouts	With live crowns
	- - - - - - Percent of treated trees - - - - - -					
Red oak	89	0	43	5	4	18
Post oak	71	12	41	41	13	27
Sweetgum	100	0	60	20	0	50
Others	69	15	53	33	0	80

Although 62 percent of all girdled hardwoods sprouted, only 3 percent of the area that had been directly shaded by these trees was directly shaded by their sprouts. August girdling, in this instance, effectively released a good stand of pine reproduction from a dense overstory of low-grade hardwoods.

In east Texas, 85 percent of all hardwood trees 10 inches and larger girdled in 1947 are dead. Many of the surviving trees appear very weak and sprouting has been negligible.

Fire for hardwood reduction has also been used here with reasonably good success. Stem killing of hardwoods was 100 percent for the 0.5-inch d.b.h. class, 97 percent for the 1-inch, 71 percent for the 2-inch, and 21 percent for the 3-inch class. Hardwood species 2 inches or smaller apparently can be controlled by burning. (See table 19 for the effect on pines of the same size.)

Near Birmingham, Alabama, three treatments were installed in 1947: (1) a commercial cut, (2) cutting all undesirable hardwood above 5.5 inches d.b.h., and (3) cutting all undesirable hardwood above 1.5 inches d.b.h. Two years after establishment, all treatments showed an increase in pine reproduction over the pretreatment tally. The increase was greater on the 2- and 6-inch diameter limit cuttings than on either the commercial cuttings or the untreated check plots. When the pine reproduction is grouped into two height classes (7 to 24 inches and 25 inches and taller), the treated plots show a loss in number in the smaller height class but a gain in the larger class. Check plots, on the other hand, showed an increase in number of stems in the smaller size but a decrease in number of large stems.

All three treatments resulted in a heavy growth of weeds and grasses which apparently crowded out smaller reproduction, but had no serious effect on seedlings over 25 inches high. Under the overstory competition of the check plots, young pines survive for a few years, then mortality becomes severe. Logging damage was heaviest in the groups that were 25 inches or over in height. This combination of circumstances suggests that improvement cuttings are best made when reproduction is large enough to compete successfully with the herbaceous vegetation that comes in following cutting, but not so large as to suffer seriously from logging damage. As at Crossett, it appears that a very favorable time to release pine reproduction by cutting overtopping hardwoods is when the pines are about 2 to 4 feet in height.

Chemical control of undesirable hardwoods

Under the stimulus of early work at the Alexandria Branch and further tests at other locations, the use of Ammate for hardwood control has about doubled each year since 1946. In 1949, private timberland owners in the Station territory treated at least 30,000 acres, and half again as much acreage was treated by the National Forests.

In east Texas, a saving of approximately 25 percent in labor cost resulted from applying Ammate in "cups" or notches made in the trunk at convenient chopping height rather than at the base of the stump. One year after treatment, however, crown kill was poorer in the "high" treatment and the stumps were sprouting more vigorously.

At Crossett, Arkansas, Ammate solution in frills resulted in better and faster crown kill but more sprouting than when Ammate crystals are used in cups. Two years after treatment all trees were dead or heavily damaged where a 37.5 percent Ammate solution was applied in frills. A 19.3 percent solution in frills killed 98 percent of the treated trees. Ammate crystals in cups at the ground killed 77 percent, and crystals in cups at convenient chipping height killed 62 percent. In the same order, percentages of trees sprouting were 68, 77, 11, and 9. Sprouting has not seriously interfered with the development of a seedling stand.

In tests in north Mississippi, 69 percent of the trees treated with Ammate were dead or nearly so one year after treatment. Mortality of girdled trees was 54 percent. Only 6 percent of the poisoned trees sprouted, while 63 percent of the girdled trees had one or more sprouts. Treating with Ammate was nearly twice as expensive as the single-hack girdle.

In north Arkansas, the time of day when the Ammate was applied affected sprouting. Ammate crystals were placed in cups at the base of 1- to 4-inch persimmon trees at three different times of day. Sixty-nine percent of the trees treated at 8 p.m. sprouted, 55 percent of those treated at 4 p.m. sprouted, and only 25 percent of the ones treated at 6 a.m. sprouted.

Second-year examination of a small study of scrub oak control on longleaf pine land in south Alabama showed that either pulling the oaks with a tractor or cutting them with an ax allowed prolific and vigorous sprouting, whereas poisoning with Ammate crystals in cups near the ground was highly effective. The crowns of Ammated trees averaged 90 percent dead, and only 27 percent of the treated trees had sprouted.

The results of applying Ammate with a Cornell tree-killing tool were observed on an operation of the Jackson Lumber Company near Florala, Alabama. A very strong solution was used: 8 pounds of Ammate crystals per gallon of water, making about $1\frac{1}{2}$ gallons of solution. The tool injected 0.4 oz. of solution (0.2 oz. of Ammate) at each application. One-inch trees were given one injection, 3-inch trees two injections, and 6-inch trees three to five injections.

Poisoning was done from April to August 1948. By July 1949, 24 percent of the treated trees were dead, and 74 percent were dying. Thirty percent of the trees had sprouted. The average crown kill was 80 percent. On 2 percent of the trees the treatment had no effect. Generally speaking, the larger the tree, the harder it was to kill. Bluejack oaks were the easiest species to kill, blackjack and dwarf post oak next easiest, and turkey oak and southern red oak hardest. Difference in month of treatment from April to August was apparently not significant.

The average cost per acre was: Ammate, at $14\frac{1}{2}$ cents per pound, \$1.27; labor, at 60 cents per hour, \$2.60; and overhead and miscellaneous, \$0.40; total, \$4.27. An average of 501 trees per acre were treated at a cost slightly less than nine-tenths of a cent per tree. The trees averaged about 2 inches d.b.h.

Though direct, conclusive comparisons of Cornell-tool poisoning with cup-crystal poisoning have not been made, it seems that while the Cornell-tool method may be slightly less effective, it is cheaper, safer, and more suitable for trees less than 4 inches d.b.h.

In a demonstration near Alexandria, Louisiana, all scrub oaks on 1/4-acre plots were treated with Ammate in August 1946. By October 1949, the area was stocked with loblolly pine at the rate of 552 per acre. These pines average 3.2 feet in height. On adjacent check plots, there are 360 pines per acre, badly suppressed and averaging only 12 inches in height. Most of these pines will die unless released.

Management of commercial stands

Shortleaf-loblolly pine-hardwoods.--The second series of compartments in a comparison of management systems received harvest cuts at Crossett, Arkansas, in 1949. This series is one of short rotation for small products.

Cut per acre on these short-rotation compartments was very low, as is shown in table 15. Logging costs per thousand (Doyle scale) were relatively high for all systems. As found in 1948, logging costs per thousand were lower, in general, on the areas with the higher average log size. The area marked on the selection system yielded logs of the largest average size, and logging costs were lowest, which follows the 1948 trend. Group-selection and seed-tree systems were second and third respectively in the order of average log size and logging costs.

Table 15.--Volume cut and costs by different harvest-cutting methods in the shortleaf-loblolly pine-hardwood type, Crossett Experimental Forest

Compartment	Total logged	Logged per acre	Average log size	Logging cost per M (Doyle scale)
	Board feet (Doyle scale)			Dollars
			Seed-tree	
84	10,790	275	31	23.81
94	7,804	202	33	22.32
Total and average	18,594	239	32	23.18
			Group-selection	
20	6,834	184	40	23.10
30	1,685	43	35	19.46
Total and average	8,519	112	39	22.38
			Selection	
40	6,045	155	62	18.62
72	5,707	145	35	22.82
Total and average	11,752	150	45	20.66

In 1939, a study comparing two intensities of thinning was installed in a stagnated 35-year-old stand of old-field loblolly and shortleaf pine near Crossett, Arkansas. One treatment reserved approximately 200 crop trees per acre and the other reserved about 100. Volume growth has been about equal in both treatments, as was diameter growth of the 70 largest trees per acre. However, diameter growth of all trees was slightly better on the heavy thinning treatment. Average annual cubic volume growth was 1.0 cord per acre. Growth of trees 10 inches d.b.h. and larger averaged 521 board feet per acre annually during the 10-year study period.

In east Texas, a series of harvest cutting plots was installed to test the financial potentialities of various systems of all-aged and even-aged management. The cutting systems used are: progressive clear-cutting strips, seed tree, shelterwood, and individual tree selection. The clear-cutting strips are 150 to 200 feet wide, with reproduction to be seeded in from adjacent blocks of mature timber.

On the seed tree areas, 10 to 15 trees, selected for size, quality, vigor, and seed production, were left per acre. Two shelterwood cuttings left 25 and 40 trees per acre respectively.

The selection-system plots will be cut every 5 years. Approximately 20 percent of the sawlog volume will be removed at each cut. A sawlog volume of 500,000 board feet (International 1/4-inch rule) was logged during 1949.

One study of the reproduction that was on these experimental plots before cutting showed only 12 percent of the area to be stocked with small trees. Because of the heavy hardwood understory and the very limited amount of pine reproduction, prescribed burning has been included as part of the management for all treatments. The first burn, covering about one-third of the area, was made in November. The fire greatly reduced the hardwood understory, but one or more additional burns may be necessary to keep the hardwoods under control until a good seed crop is obtained.

To test the D+6 system of marking, the first installation of a 5-year replication was established in a well-stocked stand of shortleaf-loblolly pine on the San Jacinto Experimental Forest in Texas. An adjoining area managed by individual tree selection will serve for growth comparison.

A simple method-of-cutting study in a 55-year old-field shortleaf-loblolly pine stand was established in east Texas to show results of different types of management. A third of the stand was clear-cut to a 10-inch diameter limit. On another third, a 30-tree shelterwood stand was left; it will be removed as the new stand becomes well established. In the third portion of the stand, a crown thinning was made, leaving enough space between individual trees for desired crown development. In January 1949, half of each plot was burned to control understory hardwood and brush.

Near Birmingham, Alabama, a study has been installed to evaluate two methods of volume control. The first system uses diameter as a cutting guide; every 5 years, all trees above 9, 15, and 21 inches d.b.h. will be removed from one series of plots. The second method uses density as a criterion; every 5 years, another series of plots will be cut back to 50, 75, and 100 square feet of basal area.

Longleaf pine.--At Brewton, Alabama, cutting was completed on six 40-acre compartments of a second-growth stand early in 1949. Two cutting methods were used: seed tree and a silvical improvement cut, which is preparatory to a later group-selection treatment. In one of the improvement-cut compartments, all trees 14.5 inches d.b.h. and larger were cut to reduce the stand to an approximation of 40-year age. Other plots will be given similar treatment in 1950.

In 1934, 16 1/10-acre plots were established in 22-year-old longleaf pine stands at each of two locations in Baldwin County, Alabama. The stand in 1934 averaged about 2,300 trees per acre at the first location, and about half that number at the second location. Three intensities of thinning were compared with unthinned checks. The plots were remeasured for the third time in 1949, 15 years after thinning (table 16).

Table 16.--Development of second-growth longleaf pine during 15-year period following thinning. Baldwin County, Alabama

Trees left per acre, 1934 (number)	Net growth per acre in 15 years: Volume		Net growth per acre in 15 years: Basal area	Aver. d.b.h. growth of 100 largest trees per acre	Stand per acre (1949) plus volume cut in 1934
	Cu.ft.[1]	Cords[2]	Sq.ft.	Inches	Cords
Thinned plots					
202	1,481	18.7	46.3	3.2	27.5
170	1,512	18.7	45.0	3.5	29.1
270	1,803	22.9	55.5	3.2	32.2
240	1,512	19.0	47.5	3.3	27.6
348	1,801	23.0	57.1	3.1	31.4
310	1,876	23.6	56.1	3.1	31.3
Unthinned plots					
2,270	1,659	22.4	31.6	2.5	29.2
1,178	2,238	27.7	59.1	3.1	33.8

[1] Trees 3.5 inches d.b.h. and larger.
[2] Trees 4.5 inches d.b.h. and larger.

General observations and conclusions from the remeasurement of these longleaf pine stands are:

1. Thinning is beneficial. Although there has not been much difference in volume growth and total production, growth on thinned plots has been on fewer and better trees, which made better diameter growth than did those on the unthinned check plots. The thinned stands are in better condition for continued growth. Thinning also yielded revenue to meet current expenses.

2. Initial stand density is important in evaluating thinning. Thinning was more beneficial in the heavier stands, and it appears that the initial thinning could well have been delayed in the lighter stand.

3. Degree of thinning, or density of reserved stand, can be varied considerably without seriously affecting growth and yield.

4. Through the 15-year period, the rate of diameter growth of the largest trees declined slightly in all treatments, indicating that age as well as stand density is an important factor in diameter growth.

Bottomland hardwoods.--In 1947, cutting began in a mixed oak-mixed hardwood saw-timber stand in the northern part of the Delta section of Mississippi. Volume per acre averaged about 3,500 board feet, Doyle scale. Some leftover old growth was included in addition to the second growth which had developed after a heavy cut of the original stand about 30 years ago. The initial stand contained approximately 105 square feet of basal area per acre in trees of varied sizes, quality, and species. The area was marked for a harvest cut; the marking included salvage trees and improvement cutting commensurate with the economics of a standard hardwood lumber mill. The cut removed about 15 square feet of basal area, almost 2,000 board feet (Doyle scale) per acre, in trees 18 inches and up.

In 1949, on a part of the area where two growing seasons have elapsed since cutting, 200 increment borings were obtained to study the immediate effect of release on the residual stand. The results are shown in table 17. Degree of release was estimated by considering the competitive position of the tree before cutting in relation to the extent of effective release. Heavy release constituted removal of at least one-half of the effective competition to suppressed trees and three-fourths or more of the competition to intermediates and codominants. Medium release ranged from removal of one-third of the competition to suppressed trees to two-thirds or more of the competition to dominants. Light or no release ranged down from medium. Removal of overtopping competition was given more weight than that from the side.

Table 17.--Growth by diameter classes and degrees of release before and after cutting in a bottomland hardwood stand in the Mississippi Delta

D.b.h. group (inches)	Trees in sample	Radial growth 1938-1947	1948-49 growth related to the rate of the previous decade
	Number	Inches	Percent
Heavy release			
6-10	13	1.03	131
12-16	24	.94	122
18+	5	1.40	107
Medium release			
6-10	15	1.14	101
12-16	17	1.38	105
18+	17	1.29	89
Light and no release			
6-10	51	1.03	82
12-16	35	1.42	84
18+	23	1.21	87

These data illustrate the need for fairly heavy cuttings if growth is to be stimulated. Medium release is effective in preventing a deceleration in the growth rate.

Two years after cutting, the residual trees in a 55-year-old cottonwood stand have shown considerable increase in the rate of growth as compared with the rate for the decade before cutting. In 1947, the growth rate was found to have been decreasing for approximately the past 12 years. About 11,000 board feet per acre were removed, reserving approximately 9,000 per acre for growing stock. During 1948 and 1949, the residual stand in the 20- to 30-inch diameter group has grown at a rate 32 percent greater than during the 10 years prior to cutting. For trees above 30 inches in diameter, this rate has been 62 percent greater. If the present growth rate is maintained for 10 years, trees in the smaller diameter group will increase 3.7 inches in diameter and trees in the larger group 6.0 inches.

In east Texas, a plan has been completed and compartments established to compare three methods of cutting on about 85 acres within the 1,300 acres of bottomland hardwoods on the Stephen F. Austin Experimental Forest. Merchantability alone determines which trees are cut in the first treatment, while silvicultural improvement as well as merchantability is considered in the second treatment. The third treatment resembles the second, but additional improvement is effected by deadening certain classes of unmerchantable trees. The areas have been marked for cutting as soon as possible.

Natural regeneration

Longleaf pine.--In 1948, estimates obtained with seed traps in Mississippi showed that approximately three-quarters of the longleaf pine seed had fallen by the end of November. Seventy-six percent of the seed that fell was good enough either to sprout or to be eaten by rodents. Forty-six percent of the estimated good seed germinated and was established by March 1949, and 95 percent of the new seedlings were still living in August 1949. It appears that a relatively large proportion of the final seedling stand became established by November 30. This is significant because it suggests that unless conditions are right for rapid germination, gradual dribblings of additional seed may not contribute much to final numbers of established seedlings.

In south Alabama, the effect of shading by scrub hardwood on 1-year-old seedlings from the 1947 seed crop was studied. On the deep sands of the Escambia Experimental Forest, 13 percent more mil-acre quadrats under hardwood crowns were stocked than quadrats in the open. On average sites, the difference was only 3 percent in favor of the shaded quadrats. Apparently the shade furnished by the scrub hardwood overstory helped pull the seedlings on the poorer site through the 1948 spring drought.

Shortleaf-loblolly.--At Crossett, Arkansas, pine reproduction on two of each of the compartments being managed under the 3-, 6-, and 9-year cutting cycles was inventoried during January and February 1949. A similar inventory was made on two uncut "natural areas." Results are shown in table 18. Percentages of stocking are shown for two levels: 1,000 and 500 well-distributed seedlings per acre.

Table 18.--Stocking of pine reproduction after 11 years of selection management

Cutting cycle (years)	Compartment number	1 foot tall to 3.4 inches d.b.h.		All seedlings		All reproduction		All with good chance of survival
		1,000 level	500 level	1,000 level	500 level	1,000 level	500 level	500 level
		- - - - - - - - - Percent stocking - - - - - - -						
3	2	17	24	58	73	65	79	46
	55	40	55	59	75	72	84	58
6	32	41	56	36	49	60	74	43
	45	29	42	68	79	74	84	57
9	22	7	15	29	43	32	51	33
	33	45	57	57	71	77	86	72
Natural areas	41	2	4	23	33	23	34	3
	42	21	34	46	54	53	59	10

Length of cutting cycle has thus far had little apparent effect on the restocking of selectively cut areas. Hardwood competition has been the chief deterrent to the development of pine reproduction on the managed as well as on the natural areas.

Mensuration

Mensuration activity during 1949 has been principally devoted to providing branches, divisions, and outside agencies with technical review of plans and articles, and with advice and training in mensuration, experimental design, and statistical analysis.

Tabular values were calculated to enable a simple European variable plot radius tree-sampling technique to be used with American measures. The advantage of the technique is that the user, by merely counting trees, can obtain basal area per acre without leaving the plot center or measuring the diameter breast high of a single stem. The technique was tested and found to be rapid, unbiased, and accurate if a critical angle is selected somewhat beyond the range of angles used in Europe. Additional uses of the technique were developed.

Additional checks on lumber quality indices were made for the Southern Pine Log and Tree Grade Committee, and a final revised set of indices was prepared and used in working up quality indices for 1,200 logs. A plan for subsequent log grade analysis was prepared for the Committee.

Some short-cut volume techniques using one or two sampled tree or log variables were developed and expressed as formulae to be ocularly corrected for unsampled variables.

It was verified by the Brewton Branch that personal bias and wet bark bias caused by rain might easily account for consistent differences of as much as 0.1 inch in successive measurements of longleaf pine d.b.h. outside bark. This may partially explain inconsistencies which sometimes occur in the analysis of growth data from periodic remeasurements.

Fire

Longleaf pine

On the Chickasawhay Ranger District of the Mississippi National Forests, the protracted drought from October to early December 1949 resulted in practically a total failure of longleaf seedling establishment, despite pre-seedfall burning and ample fall of seed. This serves to remind that seedbed preparation is only one of the ingredients required for successful natural regeneration of longleaf pine.

In south Mississippi, a study of the number of longleaf seedlings germinating in open plots and in adjacent plots screened with ½-inch mesh hardware cloth showed that screening made but little increase in the catch on fresh burns. In nearby older roughs screening increased the catch considerably. The average numbers of seedlings per acre in 1949 from the 1947 seedfall were:

	Open	Screened
Fresh burn	42,700	46,200
Old rough	8,300	22,600

The light losses on open plots in fresh burns indicate that birds made no important inroads into the seed supply. The heavier losses in older roughs where birds seldom feed indicate that rodents and insects were active. In 1948, a 10-acre area burned in October showed similar light losses, with 46 percent of the estimated total good seed germinating in the open, against 59 percent in 1947.

In Louisiana and Mississippi in 1935 and earlier seed years, birds ate so much of the seed in small fresh burns in cut-over areas with old-growth seed trees that it has been thought necessary to burn a year before seedfall so that a light rough can develop to hide the seed. If light losses on fresh burns prove to be the rule, however, the expense of careful surveys 1 year before seedfall can be eliminated by postponing burning until the time and the location of good seed crops are apparent.

Early results of a test of longleaf seedling growth on soil where pine logs have burned indicate that most of the first-year superiority in longleaf seedling development in such situations is due to reduction of herbaceous competition rather than any fertilizing or mulching effect of wood ashes. An interesting observation on brownspot was made in connection with this test. Half of the plots were sprayed with Fermate in May and July, and with Bordeaux mixture in July and October. By the end of the growing season, an average of 18 percent of the needle tissue on the sprayed seedlings was dead. On unsprayed seedlings the average was only 6 percent. Contrary to previous observations, spraying on these plots did not reduce the total number of brownspot lesions and apparently damaged the foliage.

A study of the fire resistance of longleaf seedlings shows that seedlings germinating in 1-year and 14-year roughs on the Harrison Experimental Forest did not attain the high fire resistance that is supposed to characterize this species 1 year after germination. Only about one-third of the yearling seedlings burned in January and March 1949 are expected to survive. Survival was only a little better in 1-year rough than in 14-year rough, because in the latter 1947 seedlings were usually found on thin or bare spots in the rough. In contrast to this, on fresh burns 93 percent of the seedlings germinating in November 1947 survived March 1949 fires because the rough was so thin that it would not burn well.

A reexamination was made of the old Dry Prong study of fire and longleaf seedlings near Alexandria, Louisiana. The three or more wildfires since 1942 had obscured most of the effects of post-germination prescribed burning, but it was evident that seedbed-preparation burning had lasting effects on both stand density and height growth. In 1948, 1-year roughs at seedfall (1935) had about 4 times as many seedlings and saplings as 2-year and older roughs, and the average height of the 100 tallest longleaf per acre was about 11 feet, against 8 feet on the older roughs.

Brownspot estimates made in 1942 and 1943 in south Mississippi show that summer burns (July 1940) were more effective in controlling brownspot than winter burns (January 1940).

Near Birmingham, Alabama, second-year mortality of longleaf seedlings on plots burned before seedfall was extremely heavy, slightly over 50 percent. On adjacent unburned areas, the mortality was only 6 percent. Seedling establishment had been 3 times as great on the burned area. Apparently, the hardwood leaf litter on the unburned area afforded considerable protection and the light grass cover did not offer much competition.

Shortleaf-loblolly pine-hardwood

On the Sam Houston Ranger District of the Texas National Forests, areas were burned over with a headfire in March 1948, after back fires and flank fires proved ineffective. Flames varied from 3 to 15 feet in height. The south wind had a velocity in the open of 8 miles per hour but was reduced to 3 miles per hour in the brush understory. Rate of spread of the fire ranged from 2 to 10 chains per hour. Aboveground kill of vegetation on the areas sampled is shown by diameter classes in table 19.

Most of the hardwoods and many of the shortleaf pines have sprouted. A large proportion of the pine in the smaller diameters was killed, but this is of little concern because the original pine stocking was entirely inadequate (less than 10 percent) and new regeneration was needed anyway.

Table 19.--Effect of prescribed burning in the "Big Thicket" area, Sam Houston Ranger District, Texas National Forests

Stem diameter 6 inches above base (inches)	Proportion of trees killed	
	Pine	Hardwood
	- Percent -	
0.5	100	100
1.0	90	97
2.0	33	71
3.0	8	21

The understory brush of this Big Thicket area has been significantly reduced by this single burn. Although the hardwoods sprouted prolifically, it is believed that the low cost of burning gives it promise as a tool to control hardwoods in many of the pine stands of east Texas.

Forest Soils

Rehabilitation of forest soils

A study completed during the year in north Mississippi compared some litter and soil properties under 13-year-old loblolly and shortleaf pine plantations with those under adjacent native grass cover. It was found that pine plantations produce more litter than do adjacent open areas of native grass of the same age. In 13 years, loblolly pine has produced 10 tons of litter per acre, shortleaf pine 7 tons, and grass only 4½ tons. The litter beneath pine is higher in nitrogen, calcium, and excess base than grass litter, and a deeper new A_1 horizon is being developed. The topsoil is cooler in summertime under pine litter. Invasion of hardwood tree species appeared to be greater in the pine plantations, and more macrofauna inhabit the litter and top mineral soil layer under trees. No significant differences were found in the chemical composition and other physical properties of the soil under the different cover types.

Selection and mapping of gullies for a test demonstration of accepted gully control methods is nearly complete.

Several chemical and physical properties were determined for the seven principal soils of north central Mississippi and western Tennessee.

Field work was started on a study of the soils of the Bankhead National Forest in Alabama. The object is to explore the possibilities of using some physical characteristics of these soils as indicators of tree growth potentialities. There are indications that those factors which have an effect on, or are the result of, subsoil moisture conditions are likely to prove most useful. Slope, subsoil consistency, drainage, and depth to an impeding layer seem to be the most promising to date.

Grass and legume test plantings

Another year of observations of the grass and legume test plantings in north Mississippi has added a few more species to the list that may be suitable for erosion control. These have been slow starters but appeared stronger during 1949 than in 1948: KR-yellow bluestem (*Andropogon ischaemum*); trefoil (*Lotus major* and *Lotus uliginosus*); Blackwell switchgrass (*Panicum virgatum*); weeping lovegrass (*Eragrostis curvula*); narrowleaf Wilmington Bahia (*Paspalum notatum*).

Pine Sawfly

For several years, the pine sawfly (Neodiprion sp.) has been defoliating a large number of trees throughout south Arkansas. In the Fordyce area, the height of this infestation was reached in 1946, although many trees have been partially defoliated in later years.

To obtain an estimate of the growth loss, four stands that were quite heavily defoliated in 1946 were sampled in the spring and summer of 1949. Two of the tracts--all in the Fordyce area--were 20 acres in size and two were 40 acres. A 10 percent line-plot sample was obtained from each. Radial and diameter growth was determined for each pine tree for each year from 1945 through 1948. The volume of each tree at the time of inventory and the amount of board-foot volume growth produced by each tree during each year from 1945 to 1948 were calculated. These data permit a comparison of the volume growth per acre during the year preceding the first defoliation with the growth each year following the first defoliation (table 20).

Table 20.--Pine growth loss per acre caused by sawfly defoliation

Stand number	Area	Growth reduction from 1945			Proportional growth reduction from 1945			Value per acre of growth reduction at $25.00 per M ft.		
		1948	1947	1946	1948	1947	1946	1948	1947	1946
	Acres	Bd.ft. Int.¼" kerf			- - Percent - -			- - Dollars - -		
1	20	197	184	142	44	41	32	4.92	4.60	3.55
2	20	50	32	26	19	12	10	1.25	.80	.65
3	40	70	62	64	25	23	23	1.75	1.55	1.60
4	40	110	151	108	29	40	29	2.53	3.78	2.70

Either as a result of the original defoliation or because of the moderate amount of defoliation that has taken place each year since 1946, a continuing fairly uniform loss has occurred for each of the 3 years, 1946 to 1948 inclusive.

It is clear that even though little or no timber is lost through mortality, the sawfly each year has caused growth losses in south Arkansas amounting to hundreds of thousands of dollars. If it becomes possible to forecast in advance where heavy infestation can be expected, control measures, even though costly, seem to be well justified.

Black Turpentine Beetle

The black turpentine beetle (Dendroctonus terebrans), usually considered a secondary insect that rarely kills trees, has been found the cause of mortality on the McNeill Forest in south Mississippi. In August 1949, it killed 96 merchantable pines on about 720 acres of upland pine. Some additional killed trees were below merchantable size, and many others had deteriorated beyond possibility of salvage. Most of the killed trees had been vigorous dominant and codominant individuals, 8 to 16 inches in d.b.h. The trees that were killed were usually near fresh stumps. First signs of attack are the customary pitch tubes near the base of the tree. Death occurs 3 to 6 months after initial attack. Mortality of infested trees has been practically 100 percent—rarely does a tree recover after being attacked.

Farm Forestry Research

Alabama

A work plan was completed and a study initiated on the contribution of the farm woodland to a farm enterprise. The first farm studied is a unit of the Piedmont Substation of the Alabama Agricultural Experiment Station near Camp Hill, Alabama. This unit is a dairy and cotton farm. After the farm records were collected, additional analyses were started to determine what part the woodland would play if the unit were to be operated as purely a cotton farm, as a beef-producing farm, or as a general farm. It is expected that these analyses will develop a working knowledge of the place of the farm woodland in these different types of farming.

Mississippi

The office report of the north Mississippi plantation survey was completed. Two short manuscripts have been published and a third has been submitted.

In cooperation with the Mississippi State College, a 300-acre farm forestry unit was established near Newton, Mississippi. This tract will serve as a demonstration to the farmers in the vicinity, and the records will show the returns from a well-managed farm woodland.

FOREST ECONOMICS

Forest Resources

Timber resources in Mississippi

The second forest survey of Mississippi was made from 1946 to 1948. The first survey was made in 1932-35. The findings as to timber inventory, growth and drain, and changes in the timber resource during the 14-year period were published as Forest Survey Release 59. Work was also begun on a detailed report analyzing the forest situation in the State.

The forests which support Mississippi's important timber-products industries cover 16.5 million acres out of a total of 30.3 million acres of land in the State. This is 2 percent more forest land than there was at the time of the first forest survey.

Sawlog growing stock totals 29.3 billion board feet, an average of 1,776 board feet per acre of forest land; in the 14 years, it has decreased 24 percent. Sawlog growing stock in north Mississippi, already heavily depleted at the time of the first forest survey, dropped 40 percent. In central Mississippi the drop was 25 percent; in the Delta, 29 percent. Only in south Mississippi has there been a net increase in sawlog volume--3 percent in 14 years.

Total growing stock, which includes trees 5 inches in diameter and larger, amounts to 7.7 billion cubic feet, or 466 cubic feet per acre of forest land. For the State as a whole, total growing stock decreased 10 percent in 14 years. There was an 11 percent increase in south Mississippi, but the other regions showed a decline--the north, 26 percent; the central region, 8 percent; the Delta, 18 percent.

The declines in over-all volume are great enough to present a serious problem in themselves. What makes them more significant is that the heaviest declines are occurring in the most desired tree species, the best quality trees, and the biggest trees.

A great shift from pine to hardwood is occurring. Between the two forest surveys, pine forests (those in which pines make up at least a fourth of the dominant trees) were converted to hardwood forests on 2.2 million acres. Heavy cutting of pine and aggressive growth of hardwood trees on the uplands are mainly responsible for this shift. Hardwood sawlog volume dropped 20 percent, in contrast to a decline of 29 percent for pine. In total growing stock, hardwood remained unchanged while pine dropped 20 percent.

Current annual net growth in Mississippi is about 530 million cubic feet on total growing stock, 1.8 billion board feet on sawlog growing stock. Of the total net growth in cubic feet, nearly two-thirds is hardwood. Hardwood total growth exceeds softwood in each of the regions except south Mississippi. In the pine forests, about a third of the total net growth is hardwood; and in the stand of cordwood-size trees in the pine forest, over two-thirds of the net growth is hardwood.

Timber quality, generally speaking, is low. More than 60 percent of the hardwood sawlog timber in each of Mississippi's four regions is in grade 3 logs—small logs or logs which would yield less than one-third of their volume in higher grades of lumber, and logs whose defects limit their usefulness to ties and timbers. As for softwood, 62 percent of the volume is in grade 3 trees which have less than 12 feet of clear bole.

One important aspect of the decline in quality is the increase in cull timber. Cull trees, almost all hardwood, now take up a fourth of the entire growing space in terms of basal area. Their volume increased 22 percent since the first forest survey, primarily because new culls have appeared at a much faster rate than old ones have died or been removed.

Many growing-stock trees, if permitted to grow, will develop into high-grade timber. The trend, however, as influenced by cutting, is toward smaller trees. In softwood species, trees 6 inches in diameter at breast height increased in numbers between the two surveys; 8-inch trees about held their own; and the numbers in all larger classes declined. The rate of decline was sharper with increasing diameter, up to 67 percent for 26-inch and larger trees. For hardwood species, the story is similar except that the small trees showed increases in all sizes up through 14 inches in diameter and the decreases in larger sizes were less severe than for softwoods. More than a third of the total hardwood growing-stock volume is in trees of less than sawlog size. Another third is in sawlog trees smaller than 16 inches in diameter.

Timber resources in Arkansas

The Station is currently engaged in a forest survey of Arkansas. The field inventory in the Ozarks region was finished in 1948, and findings were published in Forest Survey Release 57. In the southern half of the State, the timber inventory was virtually completed during 1949. The Ouachita Mountains and the Delta north of the Arkansas River will be surveyed in 1950.

Timber resources in Tennessee

The Station completed its inventory of the forest resources of western and central Tennessee. This portion of the State, comprising three Forest Survey regions, contains 6.2 million acres of forest land, about half of the State total.

West Tennessee, which extends from the Mississippi River to the northward course of the Tennessee River, has 1.8 million acres of forest land (30 percent of the total land area). Total growing stock in this region is 803 million cubic feet, of which a third is in cordwood trees. Sawlog volume in hardwood types averages 1,817 board feet per acre, and in softwood types (chiefly shortleaf pine), 893 feet.

The west-central region, comprising 3.4 million acres in the first 11 counties east of the Tennessee River, is 62 percent forested. Total growing stock amounts to 735 million cubic feet, of which only 5 percent is softwood. Sawlog volume in the hardwood types averages 862 board feet per acre.

The central region, which extends east to the Cumberland Plateau, contains over 6 million acres. It is 37 percent forested. Upland hardwoods are the dominant type, but cedar stands comprise 28 percent of the forest. Growing stock totals 837 million cubic feet, of which 6 percent is cedar. Half of the growing stock is in cordwood trees. Sawlog volume in hardwood types averages 1,444 board feet per acre, and in softwood types (largely cedar), 358 board feet.

Forest resources of the Delta in Mississippi

The Station furnished material for a chapter on forest resources in "The Delta Looks Forward," a book recently published by the Delta Council.

Wood naval stores stump supply in south Mississippi

About 17 percent of the total U. S. output of rosin and 10 percent of the turpentine are currently being produced in Mississippi from resinous stumps and other lightwood left from logging the original forests of mature longleaf and slash pine in the southern part of the State.

Six wood naval stores distillation plants, two at Hattiesburg and one each at Columbia, Picayune, Gulfport, and Laurel, use over 500,000 tons of wood annually.

From data collected during the recent resurvey of Mississippi forest resources, the present supply of resinous longleaf and slash pine stumpwood suitable for wood naval stores production was estimated at 6½ million tons, compared with 16½ million tons estimated in 1935.

By rough estimate, wood naval stores operations between 1935 and 1948 reduced the stump supply in south Mississippi by about 7 million tons. Rot, fire, local use of lightwood, and land clearing further reduced the supply. It would appear that south Mississippi has stumps enough for 10 to 15 years' more operation at the present rate.

Atlas of forest-economic information

The Southern and Southeastern Forest Experiment Stations cooperated in the compilation of an atlas of forest-economic information for the South. The purpose of the atlas is to assemble in one place, and provide for keeping up to date, those items of forest-resource and forest-industry information that are most generally useful to individuals and agencies within the region.

The atlas, which has been prepared in limited numbers for circulation to subscribers who will make very frequent use of it, contains regional data on forest area; timber volume, growth, and drain; timber production; forest industry; value of forest products; and income and employment from forest products. From time to time, as the forest survey and other studies make new data available, additional tables, maps, and charts will be published for insertion in the atlas.

Forest Industry

Mississippi's forest industry

Forest survey data on timber production and forest industries in Mississippi were analyzed and published as Forest Survey Release 62.

Mississippi's timber-products industries rank just behind farming as a primary source of wealth in the State. In 1946, they contributed 23 percent of the total income payments of 888 million dollars from all forms of private enterprise and provided 68,000 man-years of employment.

The total cubic volume of the 1946 cut of all timber products, in the round or split piece, is 473.5 million cubic feet—239.3 million in hardwood, 234.2 million in softwood (table 21). Sawlogs are the major product, both in softwood and hardwood species.

Table 21.--Distribution of volume of output by product and species group, 1946

Product	Total	Softwood	Hardwood
	- - - -	Percent	- - - -
Sawlogs	46	54	37
Fuel wood	19	5	34
Pulpwood	19	31	8
Poles and piling	3	6	0
Cooperage bolts	3	(1/)	6
Veneer logs	3	1	5
All other	7	3	10
Total	100	100	100

1/ Negligible.

The central region is the heaviest timber-producing region of the State. This region, with 36 percent of the forest area, turns out 59 percent of the softwood products and 43 percent of the hardwood products. It produces more than half the sawlogs, pulpwood, and hewn ties, half the veneer logs, and nearly 40 percent of the cooperage bolts and all other products. South Mississippi furnishes 20 percent of the total products; north Mississippi, 19 percent; the Delta 10 percent.

Mississippi's forest-products industries are based on a declining resource, but at least since World War I there has been no falling off in total timber output. Wood output has been sustained primarily by a tremendous increase in pulpwood production (for which small timber is preferred) and by industry adjustments in the utilization of other products. One significant adjustment has been a strong shift in lumber manufacture from large mills sawing millions of board feet annually to small portable mills which are adapted to operations in scattered stands of small timber. These small mills now produce 60 percent of the total lumber output. Another important adjustment has been a gradual shift, both in lumber and pulpwood production, from relatively scarce softwood species to the more plentiful hardwoods.

In view of the large declines in the forest resource in the 14 years between the two forest surveys of Mississippi, the prospect of sustaining timber output for most products at recent levels is doubtful. In fact, unless prevailing conditions of forest management improve more rapidly than they have been doing, it seems likely that there will be significant declines in important products like softwood lumber, softwood pulpwood, and hardwood veneer.

Forest industries and timber drain in Arkansas

As part of the forest survey of Arkansas, a State-wide canvass was made to determine 1948 output of timber products other than lumber; and, with severance-tax data from the Arkansas State Revenue Department, estimates were made of lumber production in the same year. The Station also completed a survey of logging operations, which will provide a basis for converting production of wood into terms of drain on standing timber. These data were being compiled at the year's end.

Arkansas is a State of heavy forest-industry activity. In 1944, total drain on standing saw timber was more than 2.6 billion board feet, an average of 130 board feet per acre of forest land. There are just over 2,000 sawmills in the State, but 98 large and medium-size mills located principally in the southwest part of the State account for over one-half of the lumber produced. Other primary wood-using industries include 2 pulp mills, 52 plants manufacturing handles or handle stock, 36 manufacturing cooperage stock, 13 manufacturing veneer, and 20 turning out other products. In addition, 5 wood-preserving plants serve as concentration points within the State for a sizable production of railroad ties, poles, piling, and posts.

Pulpwood production in 1948

Pulpwood production in the Station's territory reached a new high in 1948. Total production was 5,025,900 cords, an increase of 14 percent over 1947. Each of the seven States showed an increase. The trend since 1936 is indicated in table 22. Total production in 1948 was more than 3 times that in 1936.

Table 22.--Pulpwood production in Southern Station territory, in alternate years, 1936-48

State	1936	1938	1940	1942	1944	1946	1948
	- - - - - - - - - -	- Thousand cords -	- - - - - - - - - -				
Alabama	283	284	423	582	569	756	982
Arkansas	112	192	486	511	642	577	617
Louisiana	779	697	838	764	749	787	954
Mississippi	282	342	630	964	1,152	1,238	1,434
Oklahoma	...	...	...	31	10	13	34
Tennessee	1/110	1/110	131	188	113	136	182
Texas	...	99	262	586	525	616	823
All States	1,566	1,724	2,770	3,626	3,760	4,123	5,026

1/ Estimated.

Pine accounted for 90 percent of the 1948 production, or 4,523,000 cords; hardwood for 10 percent, or 502,900 cords. The pulpwood went to 36 different pulp mills. Of these, 25 were located within the territory and 11 were outside--in Florida, Georgia, North Carolina, and Virginia.

New mills drawing wood from the territory went into operation during 1948 at Natchez, Mississippi; Pensacola, Florida; and Macon, Georgia. Two more mills are under construction at Childersburg, Alabama, and Natchez, Mississippi. Also, expansion or modernization has been recently completed or undertaken at several existing mills.

Wood used in manufacture

The Station participated in a national survey of wood used in manufacture in 1948. This survey was conducted as a part of the timber-requirements phase of the Forest Survey. Schedules mailed to secondary wood users throughout the Station's territory were edited, and a sample of those who did not respond to the mail canvass was visited to obtain the wood-use information at first hand.

Hardwood utilization

During 1949, a study was carried out with the object of classifying and measuring the wood products recoverable from inferior hardwoods (saw-timber size trees with no full-length logs of factory grade 2 or better) and if possible to determine relative values by tree classes. The work, which was done in cooperation with the Texas State Forest Service and the Forest Products Laboratory, was limited to three of the most common upland species--southern red oak, post oak, and sweetgum.

Recovery data by factory lumber grades were obtained from each of 106 trees, and relative values, based on the historical price relationship between the grades of hardwood factory lumber, were assigned to each tree. A tentative classification of inferior southern red oak and post oak trees was worked out. It was possible to segregate the study trees into three significant value classes entirely on the basis of standard lumber recovery.

Before practical tree grades are established, however, the recovery value of inferior trees when cut for products other than standard factory lumber must be determined. The Forest Products Laboratory's analysis of recovery from the same 106 trees shows much higher values when low-grade logs are cut into a combination of products--factory lumber from the outer cylinder; and ties, car decking, timbers, and other bill stock from the interior--than when the entire log is cut into factory lumber. More trees will be cut and further analysis of recovery data made before classifications are adopted.

Economics of Forest Management

Guides to profitable forest management

Under this project, two studies were completed during the year. The first, "A guide to profitable tree utilization," was reported on in Occasional Paper 114. This report describes a method of determining the most profitable products to take from a tree. Each section of the tree is assigned to that use which will give the greatest surplus of sale value over the direct costs of production. Overhead costs are ignored in evaluating alternative uses. The use of this method results in the greatest amount of money from a given cut of timber. Included in the appendix to the paper are the best available figures on the direct costs of producing southern pine lumber and pulpwood.

The second study, "Good trees--good lumber--surer profits," was published in the 1949 Christmas Issue of the Southern Lumberman. It explores the question of how to calculate the best size of pine tree to grow for lumber. Stands which have been managed for 12 years on the Crossett Experimental Forest were taken as a base for the calculation of the grades and values of lumber from managed pines of various sizes. "Conversion surpluses" (of gross lumber values over direct costs of lumber production) were then calculated. Finally, the best size of tree to grow was determined as the size at which the prospective rate of increase in conversion surplus just equals the net rate of return obtainable from alternative investments of equal risk. At this size, the tree is financially mature, for the net receipts of the business are maximized. If 4 percent is the rate obtainable from alternative investments, then well-managed loblolly or shortleaf pines on good sites become financially mature at about 24 inches d.b.h. Lower-grade trees, which produce less valuable lumber, become mature at smaller diameters. Site and growth rate also affect financial maturity. For a given grade of tree, slow growth brings maturity at a lower diameter than fast growth.

Studies of "guides to optimum stocking," and "guides to profitable conversion--all-aged versus even-aged management" were also begun. The purpose of the first study is to work out a method for determining the most profitable quantity of growing stock to carry in uneven-aged stands. The conversion study is being made in cooperation with a large pulp and paper company for the purpose of determining methods of calculating the financial advantages and disadvantages of all-aged versus even-aged management, with particular reference to loblolly-shortleaf pine-hardwood forests. To assure practical and usable results, both systems are being installed on experimental areas on the company lands.

Returns from well-managed commercial forests

At the Crossett Branch, a check was made to determine what success had been achieved in increasing pine stocking on the 1,000 acres of selectively managed loblolly-shortleaf pine-hardwood stands. In 1937, approximately half of the area was occupied by low-grade hardwoods, and very little pine reproduction was present. To increase pine stocking, all hardwoods 4 inches and larger d.b.h. have been cut for chemical wood or girdled. Present stocking is as follows: in trees 3.5 inches and over d.b.h., 75.9 percent of area in pine, 6.3 percent in hardwoods; in trees less than 3.5 inches d.b.h., 11.5 percent of area in pine, 0.8 percent in hardwoods. Open land makes up 1.5 percent of the area. Although a small amount of timber stand improvement work is still needed to obtain 100 percent stocking of pine, serious hardwood competition has been eliminated.

At the Brewton Branch, the first year's cut, on 77 acres of the section of managed second-growth longleaf pine, removed a total of 25,000 board feet (Doyle rule) of sawlogs, 93 poles, and 161 cords of pulpwood. The cut was made early in 1949. The delivered value of the products was $2,965. A total of 1,726 man-hours costing $1,138, truck costs of $320, and other costs of $114 made a total cost of $1,572, leaving $1,393 as net return. Of this, $507 was the logger's return (profit and risk), and the remaining $886 was left for stumpage. Table 23 gives the costs and returns per unit of producing various products.

Table 23.--Costs and returns per unit from sawlogs, poles, and pulpwood

Item	Sawlogs (per M bd.ft. Doyle scale)	Poles (per pole)	Pulpwood (per cord)
	- - - - -	Dollars	- - - - -
Delivered value	35.96	3.68	10.75
Production costs	18.59	1.35	6.12
Net return	17.37	2.33	4.63
Logger's return	6.41	.49	1.88
Stumpage value	10.96	1.84	2.75

The total costs and returns per acre for the tract (645.2 acres) were as follows:

Delivered value of products	$4.60
Production costs	2.44
Net return	$2.16
Logger's return (profit and risk)	.79
Stumpage value	1.37

Management costs per acre for 1948 totaled 33½ cents:

General property tax	$0.102
Fire protection	.062
Marking timber (77 acres)	.074
Cruise and growth study	.081
Prescribed burning (11 acres)	.010
Hardwood control (6 acres)	.006
	$0.335

Thus the net receipts from the operation for 1948, assuming an owner who hired all the management work and sold stumpage, would be $1.04 per acre for the tract. The owner might, however, mark the timber and make the cruise himself and thus add about 15 cents per acre to his receipts. Since growth is about one-third greater than the cut for the year, an additional 46 cents per acre has accrued to investment. If the owner did the cruising and marking and logging himself, his income per acre would be $1.04 + $0.15 + $0.79 = $1.98, with reserved growth ($0.46) extra.

Returns from well-managed small tracts

Projects have been established on the experimental forests at six branch stations to determine and demonstrate the financial possibilities of managing and annually harvesting timber on small tracts such as farmers' woodlands. Practices that small owners can follow are used.

This year, the Birmingham Branch made the second annual cut on the "good" and the "poor" woodland units. The good unit has about 3,500 and the poor unit about 1,500 board feet (International 1/4-inch rule) of pine and hardwoods per acre. The cut per acre on the good unit averaged 35 board feet of hardwood sawlogs and 39 cubic feet of hardwood mine props, worth $8.31 delivered at the plants. The cut, however, covered only about 7 acres of the total 35 acres. After charging $0.57 to costs of management and $5.71 to costs of production per acre, there remained $2.03 per acre for stumpage, profit, and risk.

On the poor unit, the cut per acre averaged only 14 board feet of sawlogs and 12 cubic feet of mine props, but only 5 of the total 39 acres were covered. The value of the delivered products was $2.72 per acre. After paying management and production costs, $0.08 per acre remained for stumpage, profit, and risk. This is a small return but it proves that, under existing market conditions, a poorly stocked unit in north Alabama can be improved without further net cash investment by reducing the proportion of hardwood and increasing the proportion of pine in the growing stock.

At the Brewton Branch in south Alabama, the naval stores operations on the good and poor woodland forties were more efficient than in 1948. Increased yields of gum were obtained on the poor forty by widening the faces from one-third to nearly one-half of the circumference of the tree. Faces were chipped every other week on the good and every third week on the poor forty. Bark chipping with acid was used on both areas. Turpentined trees are cut after 2 years of chipping. Timber products were being harvested as the year came to a close. Table 24 compares naval stores operations on the two forties for 1948 and 1949.

Table 24.--Returns from naval stores operations on two 40-acre tracts near Brewton, Alabama

Item	"Good 40" (Compt. 156) 1948	"Good 40" (Compt. 156) 1949	"Poor 40" (Compt. 158) 1948	"Poor 40" (Compt. 158) 1949
Number of faces worked	205	318	295	292
Total gum produced, barrels	5.93	9.48	3.72	5.88
Yield per 100 faces, barrels	2.89	2.98	1.26	2.01
	- - - - - - - Dollars - - - - - - -			
Delivered value				
Total	141.64	191.40	89.49	118.89
Per barrel	23.89	20.19	24.06	20.22
Man-hours labor				
Total	138.0	184.0	148.0	135.5
Per barrel	23.3	19.4	39.8	23.0
Per 100 faces	67.3	57.9	50.2	46.4
Gross returns[1]				
Total	120.85	174.38	68.39	103.97
Per barrel	20.38	18.39	18.38	17.68
Per hour	.88	.95	.46	.77
Per face	.59	.55	.23	.36

[1] Delivered value minus all out-of-pocket conversion costs. No deduction for stumpage or labor.

At the Crossett Branch in southern Arkansas, the twelfth annual cut on the "good" farm forestry forty produced 12,631 board feet (Doyle rule) of logs, 3.44 standard cords of pulpwood, 14.21 standard cords of firewood and chemical wood, and 41 posts. These products had a stumpage value of $321, a roadside value of $507, and a market value delivered at the mill of $694. These values indicate a stumpage return of $8.02, a roadside value of $12.68, and a market value of $17.34 per acre for the year. Over the 12 years that the study has been in progress, 149,000 board feet of logs, 290 cords of pulpwood, 209 cords of fuel wood and chemical wood, and 385 fence posts have been cut. These products have had a stumpage value of $2,437, a roadside value of $5,013, and a market value of $7,590. Gross return for the labor of harvesting the 1949 crop was $2.02 per hour. Net return per hour after deducting all carrying charges and out-of-pocket costs was $1.67. Over the 12-year period, 7,116 hours of labor have been spent in producing the forest crop. The average gross return to the owner and operator over this period has been $1.07 per hour.

The eleventh annual cut of forest products from the Crossett "poor" woodland unit (34 acres) produced a total of 10,309 board feet (Doyle rule) of sawlogs. This was equivalent to 303 board feet per acre. Stumpage value of the cut was $272, roadside value was $344, and value delivered to the mills in Crossett was $416. Per acre, the stumpage value was $8.00, roadside value $10.12, and market value $12.24. Over the 11 years, the harvest has had a total stumpage value of $1,024, or $30.10 per acre; a roadside value of $2,235, or $65.74 per acre; and a market value of $3,447, or $101.38 per acre. In the 11 years, the low quality and defective hardwoods have been nearly eliminated and pine stocking has been increased to the point that there is room for very few additional trees. A greatly increased cut will be possible in the very near future.

Improvement cuttings at the East Texas Branch were made in January 1949 on Compartment A and in December on Compartment C of the 67-acre farm woodland unit. Before cutting, Compartment A (12.7 acres) had an average sawlog volume per acre of 3,642 board feet (Doyle rule; 6,368 board feet International 1/4-inch rule); and Compartment C (13.3 acres) had a volume of 3,698 board feet (Doyle rule; 6,358 board feet International 1/4-inch rule).

In these first cuts, products valued at about $1.60 per acre on the stump were harvested. This wood had a per-acre market value of about $4.00 from Compartment A, and $3.00 from Compartment C. The felling and bucking were done by a local farmer and one helper, who worked slower than regular woods crews do. The labor requirements per thousand feet (Doyle rule) of sawlogs were 6.17 man-hours for felling and bucking and 2.80 man- and team-hours for skidding to the roadside. The total for the entire job was 116 hours, or about 14½ days.

Undesirable hardwoods on the farm woodland unit were felled, girdled, or poisoned with Ammate. Work was largely concentrated on 15.6 acres and cost a total of $45.44. The time required was 59 man-hours, figured at 75 cents per hour. Ammate cost 18 cents per pound. On a per-acre basis for the 15.6 acres actually treated, the total cost was $2.91 for treating 18 trees with an average d.b.h. of 8.7 inches. Annual cutting will proceed, with the purpose of improving the timber stand at the same time that a steady return is being realized.

At the Gulfcoast Branch, average annual income per acre from woodland forties was less in 1949 than in previous years. Some of the reasons were (a) lower gum prices, (b) a downward adjustment in annual cut to conform to estimated annual growth, and (c) relatively high percentage of dry-facing and mortality of worked trees. A change-over from straight weekly chipping to a combination of biweekly and weekly chipping (depending on rate of gum flow), however, saved enough in labor costs to offset approximately a 25 percent decrease in gum values since 1947. Dry-facing and mortality of trees being worked for gum are on the increase to an extent that is beginning to cut down the profits.

In 1948, after 2 years of turpentining, 7.7 percent of worked trees on the forties had dry-faced or died; in 1949, an additional 6.8 percent of worked trees on the same areas were dry-facing or dying. Returns, however, were still on the plus side after 3 years.

The average annual return per acre for stumpage over a 3-year period from the two poor forties was $1.98 and $1.85, respectively; for the two better-stocked forties, similar per-acre figures were $2.50 and $4.16. Of course, had the products been produced and sold at the roadside, returns would have been proportionately higher in each case. Again, the results are showing that an annual return can be obtained from the land at the same time growing stock is being improved.

In a study of net average annual returns from crude gum, trees 14 inches d.b.h. with two cups yielded higher net returns for both virgin ($0.52 per tree) and yearling ($0.62 per tree) faces in second-growth longleaf than all other tree sizes tested. The same held for virgin faces on old-growth trees. Yearling faces were not tested on old-growth trees. Except for second-growth one-cup trees, all trees 9 inches and smaller d.b.h. were worked at a loss.

At the Tallahatchie Branch, three woodland forties were established in 1949.

RANGE RESEARCH

Grazing Management

Range forage production and nutritive value

Herbage on range in central Louisiana was measured during 1947, 1948, and 1949, in very open timber stands with less than 30 pine trees per acre, 4 inches d.b.h. and larger. Grass and weed growth was closely harvested at different seasons on areas protected from fire and grazing. Average daily grass production ranged from a high of 20 pounds per acre (air-dry weight) in spring to less than 1 pound in midsummer. After a summer lag, growth usually increased in September, because flower stalks were produced at that time and because there was more moisture in the soil. Grass production per acre (air-dry) on check plots clipped only at the end of each season was:

1947	2,100 pounds, about normal for open forest range. Growing-season rainfall of 34.55 inches was about average, but midsummer was dry.
1948	1,300 pounds, or 40 percent below normal; 85 percent of this was produced before June 10. A drought year, with only 17.61 inches rainfall during the growing season.
1949	3,150 pounds, or 50 percent above normal; one-third came from an unusually heavy crop of bluestem flower stalks. Rainfall was above average every month of the growing season except May and September.

In denser timber stands, the competition for moisture is greater, and grass growth is less, but total production still responds to above-average rainfall. The following tabulation shows grass production at McNeill, Mississippi, under three stands of longleaf pine, open (about 30 pine trees 4 inches d.b.h. and larger per acre), moderate (about 225 trees), and dense (about 300 trees).

Table 25.--Maximum production of green grass in 1947, 1948, and 1949, on burned and unburned areas of the McNeill Experimental Forest

Year	Open stand		Medium stand		Dense stand	
	Burned	Unburned	Burned	Unburned	Burned	Unburned
	- - - - - Pounds per acre, air-dry - - - - - -					
1947	568	585	374	309	178	214
1948	589	474	423	210	375	212
1949	1,463	1,375	647	661	788	861

Repeated harvesting at frequent intervals reduced grass production in central Louisiana. Plots clipped every 2 weeks produced 40 percent less grass than the check plots, and those harvested every 4 weeks produced 30 percent less. However, production was not measurably reduced by harvesting at 8-week or 16-week intervals.

That high nutritive values are closely associated with rapid growth and fresh grass is shown by chemical analyses of samples from the various harvesting frequencies. All spring grass contained 8 percent or more crude protein, ample for normal growth of beef cattle. However, by early summer, protein content of green grass on undisturbed check plots was less than 8 percent. Very similar results were obtained at the Gulfcoast Branch in south Mississippi. In contrast, the relatively new grass from areas harvested every 2, 4, and 8 weeks in the Louisiana study contained sufficient crude protein throughout the growing season. These studies brought out two points of significance in managing pine-bluestem ranges in the Coastal Plain:

1. Seasonal rainfall and forage production may vary greatly from year to year. However, a fairly good forage crop was produced even in 1948, one of the driest seasons on record, because most of the seasonal growth was made in spring before the soil dried out. There was sufficient growth in that year to sustain cattle at the rate of stocking currently recommended. However, utilization of the grass is close in such dry years.

2. Moderately close grazing during the main growing season will make better use of forest range than the equivalent utilization spread out over the entire year, because the forage is most nutritious in spring, and more intensive seasonal grazing will help maintain a fairly high nutritive value during summer and early fall.

A forage inventory on the McNeill Experimental Forest brought out facts in forage growth in the branch bottom type, about which little published information is available. In the branch heads, herbage production may be as high as 4,000 pounds per acre (air-dry) of sedges and grasses, but in the average bottomland hardwood stand at McNeill switchcane, sedge, and grass production averaged only 500 pounds per acre even in a good year like 1949. This is less than half the grass under a medium pine stand, and is only one-third that in the open pine stand in the uplands.

This evaluation of the bottomland type was substantiated at the Brewton Branch in south Alabama, where it was found that on the whole the brushy bottoms that are typical of the longleaf belt are poor forage producers. On the Escambia Experimental Forest, only 20 percent as much forage per acre was found in the forested branch bottoms as on uplands in the open longleaf pine type.

It was observed during 1949 in south Alabama that cattle showed a definite preference for longleaf pine areas cut over by a seed-tree method (leaving 10 seed trees per acre) the previous winter. The observation was confirmed by the 1949 fall forage inventory, which showed the utilization on cut-over areas to be 39 percent while utilization on nearby uncut areas was 28 percent.

The cut-over area produced about 10 to 15 percent more forage the year following cutting (1949) than the year preceding (1948), while production on uncut areas was about the same each year. The increased grazing just about balanced the increase in forage production.

Grazing damage to reproduction

About 30 percent of the slash pine seedlings planted the winter of 1948-49 on 4,000 acres in La Salle Parish were grazed by range cattle.

Plot records showed that grazing did not significantly increase seedling mortality, but did affect height, vigor, and form. Grazing reduced first-year height 27 percent. Potentially, the gravest damage was to tree form. Grazing usually destroyed the terminal bud, and 78 percent of the grazed trees formed multiple leaders.

Most grazing damage occurred in February and early March, when green grass was scarce and closely grazed. The results indicate that during winter and early spring cattle should not be grazed on areas newly planted to pine.

Forest grazing in the Arkansas Ozarks

The study of grazing in sparsely stocked, poor hardwood timber stands was continued. Results apply to an estimated 25 to 30 percent of the forested area of the Arkansas Ozarks, mainly on south and west slopes where sites are poor and commercial timber production is very low. Such areas are typical of the land used for open-range forest grazing.

Estimates based on 4 years of herbage measurement show that at least 25 acres of the best woodland range are required to graze one cow per 8-month season; 50 acres or more are required on ranges where grass production is low. In contrast, untimbered, unimproved, unburned native grassland required only 12 acres per cow for the season because of greater total amounts of herbage and a greater proportion of bluestem grasses.

Burning woodlands may temporarily increase grazing capacity for 1 to 3 years, but the increase is relatively small and insignificant. A much greater increase in grazing capacity could be obtained on these sparse, poor hardwood sites simply by deadening the low-value trees and converting to open grassland.

Controlling Undesirable Hardwoods

Ammate continues to be the most effective chemical for controlling blackjack oak and similar scrub hardwoods. A USDA publication (M-5296) was prepared and released to meet the thousands of requests for information on this subject.

New chemicals, including several formulations of 2,4-D and 2,4,5-T, were tested along with Ammate at the Alexandria Branch. Good kill of tree crowns, but vigorous basal sprouting, resulted from applying strong solutions of the sodium salt of 2,4-D, Esteron 2,4,5, and mixtures of the two in frills.

Preliminary results indicate that applying a mixture of 2,4-D and 2,4,5-T in oil solution to the trunk offers a promising way to control small low-value hardwoods. In April 1949, 10 blackjack oak trees 2-4 inches d.b.h. were treated with a 2 percent mixture of 2,4-D and 2,4,5-T in oil. The chemical was sprayed on the bark all around the trunk from ground level up to 18 inches, until the outer bark was wet. In September 1949, all crowns of trees treated in April were dead. One tree produced two sickly sprouts 6 inches tall. None of the trees treated in July 1949 by the same method were dead by September 1949, so further experiments are needed before recommendations can be made.

Response of grass to hardwood control

The Alexandria Branch found that after two growing seasons, grass production on plots where scrub oaks were killed averaged 1,531 pounds per acre compared to only 804 pounds on check plots where hardwoods were not controlled. Measurements were taken in a moderately heavy stand of scrub oak on the same plots used for a study of pine underplanting. The data on grass production are summarized in table 26. Before treatment the plots where all trees were "Ammated" had a lighter stand of hardwoods and more grass than the other plots, hence the response to release was lower than with other treatments.

Table 26.--Average grass production by August 1948 and 1949 on areas given several degrees of hardwood control during March 1948

Hardwood control treatments	Grass per acre			
	1948	1949	Increase	Increase
	- - - Pounds	- - - -		Percent
Girdle--selective	700	1,513	813	116.1
Ammate--selective	684	1,699	1,015	148.4
Girdle--all trees	590	1,463	873	148.0
Ammate--all trees	841	1,449	608	72.3
All release plots	704	1,531	827	117.5
Check--no release	577	804	227	39.3

Grass production was generally low during 1948 because of the dry season. However, grass on the released plots was much greener throughout the summer than on unreleased check plots. Green grass samples taken on released plots in July 1948 averaged 58 percent water, compared to 54.4 percent water in grass from check plots.

In both years cattle grazed the released areas much more heavily than the checks. Grazing was particularly heavy in the thickets of dead oak where release was greatest. Apparently, with release, growing conditions were more favorable, growth was faster and continued longer in summer, and the resulting forage was more succulent and nutritious. Damage to planted pines varied directly with degree of grazing. Thus careful management or exclusion of grazing may be particularly important for a few years where pine planting accompanies or follows killing of scrub oak stands.

Artificial Revegetation

Improvement of summer-fall grazing

Application of 200 pounds of calcium metaphosphate and seeding 3 pounds of carpetgrass per acre on recently burned range in March 1945 proved a practical method of establishing a grazed firebreak strip and improving summer grazing on forest range in central Louisiana. The treatment cost about $7.50 per acre. The area has been grazed heavily for the five seasons since treatment. Some form of maintenance is needed, as a fairly heavy stand of bitterweeds invaded the fertilized and seeded area during the fourth and fifth seasons of heavy grazing.

A study was begun in cooperation with the Industrial Lumber Company in southwest Louisiana in April 1949, to make a further check on establishment of firebreaks by seeding, fertilizing, and grazing. All plots were disked before the treatments were applied. A standard mixture of Dallis grass, carpetgrass, and common lespedeza was used for seeding, but lime and fertilizer were varied. The plots were unfenced and were grazed by open range cattle.

By November 1949, or 8 months later, carpetgrass had formed a dense sod on all seeded plots. The areas were grazed uniformly to within about 1 inch of the ground. There was not enough vegetation at the end of the growing season to carry a fire. By contrast, nearby untreated areas of open forest range had 2,500 to 3,000 pounds per acre of dry grass herbage, which makes a high fire hazard. Applying basic slag as a fertilizer appears to be about as effective as applying a complete fertilizer plus lime.

The Bureau of Plant Industry, Soils, and Agricultural Engineering, in cooperation with this Station, made preliminary range forage seedings at the McNeill Experimental Forest in south Mississippi. The most promising species are hairy indigo, Chinese or sericea lespedeza, big trefoil, and carpetgrass. None of these species, with the possible exception of carpetgrass, can be successfully established in timber stands without fertilizers, and light cultivation appears to be essential for establishment of all grass species.

FOREST UTILIZATION SERVICE

The Forest Utilization Service continued to operate as a liaison between the Forest Products Laboratory and the timber growers and wood-using industries of the South. Analysis of various local utilization problems, together with recommendations for their solution, is a major part of the job. Also, as an integral part of the Southern Station, the Forest Utilization Service takes an active part in those phases of the research program concerned with forest products utilization. The following discussion highlights Forest Utilization Service activities in 1949.

Hardwood Log Grades and Grade Yields

To promote the use of the hardwood log grades developed by the Forest Products Laboratory, to increase the operators' knowledge of grade-yield recovery by log grade, and to improve the hardwood utilization, seven training meetings have been held, with a total attendance of 225. These meetings were sponsored by State forestry organizations, schools, industrial firms, and Region 8 of the U. S. Forest Service.

Special work along the same lines was done with the Tennessee Valley Authority, Texas Forest Service, and the Ozark National Forest in connection with mill-scale and grade-yield studies being conducted by these three agencies.

In order to obtain additional data on log grades and grade-yield recovery for southern hardwoods, several cooperative studies were conducted. The field work for the Tennessee Valley Authority's study of the relation of log grade to grade-yield recovery is about half finished. Twenty-four of the 50 selected mills have been completed. So far, 3,581 logs, containing 260,700 board feet of lumber, have been graded and the grade yield of factory lumber for individual logs obtained. Information on time requirements, amount of labor, type of equipment, and method of sawing has been obtained for analysis.

In cooperation with the Alabama National Forests, a mill-scale and grade-yield recovery study was made on 138 white oak logs from 72 trees on the Bankhead National Forest. Approximately 67 percent of the lumber from Grade 1 logs was No. 1 Common or better. Grade 2 logs yielded 36 percent No. 1 Common or better; and Grade 3 logs, 17 percent. Based on lumber price quotations from the January 21, 1950, issue of the "Hardwood Market Report," the value of net scale Scribner Decimal C for Grade 1 logs was $103.35 per thousand board feet; for Grade 2, $83.93; and for Grade 3, $77.33.

To facilitate the work in grading southern hardwood logs, data on the recognition and significance of various defects of hardwood logs were accumulated and prepared for publication. This publication, which is at the printer, contains detail photographs of actual defects and the effect of those defects under the surface. It defines, identifies, and evaluates the significance of all abnormalities on the surface and end of the log.

Wood Seasoning

Kiln-drying

To round out knowledge on direct gas-fired kilns, oak flooring stock from a natural draft manifold type progressive gas kiln in central Mississippi was checked for uniformity of moisture content and quality. Using a comparatively mild schedule, air-dried 4/4 oak flooring stock with a moisture content of about 12 to 25 percent was dried to a rather uniform moisture content in 144 hours. Over 96 percent of all the samples ranged from 5.5 to 8.5 percent moisture content.

There was no honeycombing, checking, or kiln damage that would degrade the flooring stock, although practically all samples were casehardened to some degree. This kiln now uses natural gas, having been changed over from butane. On natural gas, fuel costs ranged from 65 cents per thousand board feet during the winter to 45 cents per thousand during the summer. Fuel costs when butane gas was used amounted to $2.13 per thousand board feet.

"Direct gas-fired kilns in the South," a paper presenting the results of current work on direct gas-fired kilns, was given at the annual meeting of the Forest Products Research Society in Grand Rapids, Michigan. During the year, the Forest Products Laboratory completed final reports on the direct gas-fired kilns in Arkansas that were checked for uniformity and quality of drying. These kilns were of the forced-draft compartment type, with external blower and urn-type burners. They were drying 4/4 mixed oak flooring stock. Copies of the report were submitted to the kiln manufacturers and cooperators.

Sample logs of two species of hickory were shipped to the Forest Products Laboratory from north Mississippi for use in developing improved kiln schedules, particularly for the reduction in the amount of "pinking." Two schedules were developed and pilot-kiln runs on handle squares were made with the Forest Products Laboratory portable kiln, which was set up at Mississippi State College. Indications are that a more conservative schedule than is now commonly used will considerably reduce the amount of pinking in hickory. Schedules for the kiln-drying of hickory have been released to the industry.

Air-drying

Arrangements were made with the Forest Products Laboratory to investigate the effect of flat piling and mechanical handling of unit packages on the seasoning of lumber in the South. This work has been started in the Southeastern Station's territory and will be continued in Southern Station territory.

Chemical seasoning

The Forest Products Laboratory released an office report on the results of a study of chemical pre-seasoning. In this study, which was made in cooperation with the W. T. Smith Lumber Company, Chapman, Alabama, several species of different thicknesses of lumber were treated with Myles Lumber Cure (now called Saligna) by various methods. Results indicated that although there was some reduction in seasoning damage, the chemical did not reduce the time sufficiently to justify its use.

Additional work in chemical seasoning is being carried on by the Texas Forest Service and some east Texas firms. The study will investigate the effect of using Saligna on several thicknesses of some of the more common southern species.

Wood Preservation

The fence post preservative tests which were installed 13 years ago on the Harrison Experimental Forest were expanded to include some 45 new preservatives and combinations of preservatives. This is a cooperative project, partially financed by the preservative manufacturers.

In the cooperative fence post preservative work of those States that are within and adjacent to the Tennessee Valley Authority territory, the second year of testing and installation work was completed. Cold-soaking in a 5 percent solution of pentachlorophenol was used for several species the first year. Copper napthenate (0.5 percent copper metal) was similarly used for the second-year test. A complete report covering the results of the first 2 years' work is being prepared. A second phase of this cooperative study will determine the effect of insect peeling on the treatability of several species of posts. Seasoning periods of 30, 60, 90, and 120 days were used. Results of this study are being analyzed to determine the feasibility of insect peeling.

Veneer

In an attempt to increase the utilization of some of the southern hardwood species, sample logs of both sweet pecan and water hickory were shipped to the Forest Products Laboratory for veneer cutting tests. The best procedures, including temperature of the bolts, knife angle, speed of the lathe, and drying to produce the highest yields, were developed. Sample material was made into plywood and has been displayed to the industry. A complete report covering this project is being prepared by the Forest Products Laboratory.

Wood Molasses

The Animal Husbandry Department of Mississippi State College completed the cooperative tests to determine the food value of wood molasses. A report was published in the September 1949 issue of Mississippi Farm Research. In this test, three lots of four steer calves each were used to compare the feeding value of wood molasses with that of corn. All lots were hand-fed twice daily in dry lot for 120 days. Ground white corn, low-grade lespedeza grass hay, cottonseed meal, and wood molasses were used. Tables 27 and 28, taken from the published report, summarize the results of these trials. The figures indicate that the feeding value of wood molasses is equal to corn when one-fourth of the corn is replaced with molasses.

Table 27.--Feed consumption and results of feeding trial with wood molasses and corn

	Lot 1	Lot 2	Lot 3
	Cottonseed meal, hay, and full corn ration	Cottonseed meal, hay, 3/4 corn, 1/4 wood molasses ration	Cottonseed meal, hay, and 3/4 corn ration
Steers per lot	4	4	4
Length of trial (days)	120	120	120
Av. initial wt. (lbs.)	474	474	474
Av. final wt. (lbs.)	693	708	655
Av. gain (lbs.)	219	234	181
Av. daily gain (lbs.)	1.83	1.95	1.51
Feeds per steer (lbs.)			
Corn	1,287	952	952
Wood molasses[1]	...	335	...
Cottonseed meal	257	257	257
Hay	389	389	389

[1] Wood molasses calculated to same moisture content as corn.

Table 28.--Reversal trial comparing wood molasses and corn

	Lot 1	Lot 2	Lot 3
	Cottonseed meal, hay, and full corn ration	Cottonseed meal, hay, and 3/4 corn ration	Cottonseed meal, hay,3/4 corn,1/4 wood molasses ration
Steers per lot	4	4	4
Length of reversal(days)	30	30	30
Av. initial wt. (lbs.)	693	708	655
Av. final wt. (lbs.)	749	754	729
Av. gain (lbs.)	56	46	74
Av. daily gain (lbs.)	1.87	1.53	2.47
Feeds per steer (lbs.)			
Corn	404	303	303
Wood molasses[1]	...	...	101
Cottonseed meal	81	81	81
Hay	90	90	90

[1] Wood molasses calculated to same moisture content as corn.

Negotiations are under way with Mississippi State College to enlarge upon this test.

The cooperative wood molasses pilot plant which the Tennessee Valley Authority and the Forest Products Laboratory have set up at Wilson Dam, Alabama, got into operation and will produce some 24 tons of molasses this year. This molasses will be used in feeding trials at several southern locations. The first of these trials will be made by the Alabama Agricultural Experiment Station, which will get six tons of molasses for lactating cows.

Wood Characteristics

Cooperating with Higgins, Inc., New Orleans, Louisiana, the Forest Products Laboratory tested seven of the more commonly imported tropical woods for machining characteristics. Forest Products Laboratory Mimeograph No. 1744, "Exploratory tests on machining and related properties of 15 tropical American hardwoods," was released and has been in good demand by importing firms.

Sample logs of second-growth sweetgum, overcup oak, and cedar elm were shipped to the Forest Products Laboratory for strength tests. The forthcoming data will be used to revise Technical Bulletin No. 479, "Strength and related properties of woods grown in the United States."

Pulp Quality and Yield from Even-Age Plantation Stock of Different Spacings

This study was made to determine the effect of spacing of slash pine on wood properties and pulp yield and quality.

The physical properties of the several samples of slash pine are summarized in table 29.

These data show that the material from the 13.1-foot spacing was significantly different from the closer spacings, which differed little among one another. The yield of kraft-type sulfate pulp from the composite sample of the three closest spacings was 45.9 percent on a screened pulp basis. The screening rejects were negligible. There was: 28.5 percent lignin, 64.7 percent holocellulose, 47.2 percent alpha-cellulose.

Table 29.--Density of wood from slash pine trees grown at various spacings

Spacing (feet)	Av. bolt diameter	Av. age of bolts	Density	Summerwood
	Inches	Years	Lbs. per cu.ft.	
4.3	3.7	9.6	29.2	34.1
5.2	4.0	9.6	29.6	34.4
6.2	4.2	10.1	28.9	30.1
13.1	4.5	8.2	24.3	24.5

The yield of this pulp per cubic foot of wood was 13.2 pounds. No runs were made to determine pulp yields from the 13.1 by 13.1-foot spacing, as the lower density of the wood would give definitely lower yields of pulp. The pulp made from the composite wood sample was lower in bursting strength by about 10 percent than the average value for southern pine sulfate pulps made at the Forest Products Laboratory in the past.

Wood Waste Utilization

In cooperation with the International Paper Company, field work on a study of wood waste was completed. This is a study to determine the amount of heavy wood waste, suitable for pulp chips, that sawmills of different sizes and types produce from peeled pine logs of different diameter classes. Four classes of mills were studied: band mills with resaw, circular mills with resaw, solid-tooth circular mills without a resaw, and portable circular mills with inserted teeth. Two mills of each class in south Arkansas and two in north Louisiana, or a total of 16 mills, were selected for study of the peeled logs. At an additional mill, unpeeled logs were used as a check on volume of bark. Reports for the individual mills have been compiled and furnished the cooperating companies. These data are being analyzed and a complete report is being prepared.

Over 3,000 logs, scaling approximately 179,000 board feet net Doyle scale and weighing about 2,400,000 pounds, were measured. The waste amounted to approximately 525,000 pounds, or 22 percent of the total weight of the logs. Ninety-four percent of the waste was suitable for pulp chips. Final figures are not yet available, but preliminary results indicate a yield of from 0.2 to 0.8 of a cord per thousand board feet lumber tally. The exact figure depends upon the type and size of sawmill equipment and log diameter.

Much additional miscellaneous information is being developed from this study, including weight of logs by size class, board foot-cubic foot ratios, and overrun by size classes.

FLOOD CONTROL SURVEYS

Watershed surveys are an important part of the Station's investigative program. These studies, first authorized in 1936 as an activity of the Department of Agriculture, develop the economic facts and recommendations which are the basis for large-scale action programs for treatment of watershed lands. The surveys involve an appraisal of flood problems, recommendations for alleviating floods and sedimentation through conservation practices and better use of land, and an evaluation of prospective costs and benefits. Survey reports which show benefits in excess of costs go to Congress and are enacted into law, affording Federal authorization for accomplishing recommended work.

Progress on Current Surveys

During 1949, the survey of the White River and tributaries above Norfork, Arkansas, reached the report stage; field work on the Homochitto-Buffalo River survey (Mississippi) was completed; and a detailed survey of the Ouachita River watershed (Arkansas and Louisiana) was initiated.

Early in the year, a first-draft report on the Upper White River survey was prepared for regional review within the Forest Service and Soil Conservation Service. Before it is reviewed by other Federal and State agencies, the report will be further revised and modified, particularly with respect to flood-control action recommendations and cost-benefit analysis.

The survey of the Homochitto-Buffalo watersheds in southwestern Mississippi was well along by the end of the year. Analysis of flood damages, needed remedial measures, and cost-benefit relations was largely finished. Field work included special study of stream bank erosion--a major problem in this watershed--and ways and means of stabilizing shifting channels. Studies were also made of drainage needs on valley lands. An analysis of the probable rate of application of conservation practices in the Homochitto area, using data supplied by the Soil Conservation Service and Production and Marketing Administration, indicates that a substantial part of conservation needs will not be achieved in the next 10 years at the current rate of progress.

The Homochitto-Buffalo project is the first survey in which this Station has been engaged where total value of manufactured forest products appears to be greater than that of the total production of farm crops. In large part this reflects the substantial shift from row crops to grass and trees that is under way in this area, and large-scale abandonment of croplands which occurred during the war years.

A survey of the Ouachita River watershed in southern Arkansas and northeastern Louisiana got under way late in 1949, after considerable advance planning and preliminary study of available information. Much pertinent data have been assembled, including climatological and streamflow records, flood profiles, and floodplain maps. Streamflow records have been analyzed and flood frequency curves constructed. Farm census and conservation survey data have been compiled for area classification purposes, and major uses of watershed lands determined by analysis of aerial photographs.

Cooperative Relations with Other Agencies

The Station's flood control investigations require collaboration with State and Federal agencies. Particularly close working relations are maintained with the Soil Conservation Service--the other agency in the U. S. Department of Agriculture which has responsibility for flood control surveys. Under the existing division of responsibility, the Station assigns men to handle forestry phases of Soil Conservation Service surveys, and, in turn, is assisted by the Soil Conservation Service on agricultural aspects of the Station's projects.

Substantial assistance was provided Soil Conservation Service projects in 1949. Station personnel, detailed to the survey of the Lower Red River watershed (Texas, Oklahoma, Arkansas, and Louisiana), completed a field inventory of all forest lands and classified the woodland as to watershed condition. Similar inventories were made as a part of the Apalachicola survey (Georgia, Alabama, and Florida), and the Lower Trinity-San Jacinto survey (Texas). These data are basic in evaluating run-off and sediment contributions from forest lands and for gaging future contributions if the lands receive remedial treatment. Much of the woodland is not in good shape for watershed purposes; only 19 percent of the forest land in the Lower Red River basin was found to be in good hydrologic condition.

Cooperative activities also included formulation of forestry recommendations and statistics for the Savannah River (Georgia) report. The Station also assisted in preliminary examinations of the Altamaha-Ogeechee River watershed (Georgia) and of the combined Mobile-Alabama-Escambia-Choctawhatchee River watersheds (Alabama and Florida).

Review and revision of survey reports was also an important activity during the year. Forestry recommendations for the Soil Conservation Service report on the Lower Arkansas River were restudied and modified. Later in the year, decisions to eliminate public acquisition of certain forest lands in Oklahoma, as originally proposed, required a reappraisal of forestry proposals to determine what measures might be accomplished if the lands remain in private ownership and to what extent this would reduce effectiveness of an action program.

Formal reviews were also made of the Corps of Engineers report draft on a modified plan for the White River basin; and of reports and other material relating to flood control investigations issued by th Soil Conservation Service and other agencies.

Advance Studies and Other Activities

Advance studies were mainly centered on field reconnaissance and preliminary planning for a detailed survey of the Ouachita River drainage basin. Much of this dealt with hydrology and development of procedures which will have general application to other surveys in appraisal of flood damage and flood reduction benefits.

The Station is continually testing new techniques and methods of strengthening evaluation phases of flood control survey reports. One basic deficiency is lack of long-term rainfall and run-off records for small watersheds. In September, a stream-gaging station near Mena, Arkansas, on the Irons Fork Experimental Forest--inactive since 1943--was put in operation to supply information for evaluating hydrology of the forested mountain portion of the Ouachita River basin. Early data from Irons Fork were also assembled and analyzed with particular reference to appraising soil and geologic structure in relation to water storage.

Practical procedures for appraising condition of forest lands for water absorption and retention and for maintenance of soil stability were worked out and tested in east Texas and in the Coastal Plain and Piedmont sections of Georgia and Alabama. Criteria for judging hydrologic condition were based on field observations and earlier data indicative of litter accumulations, humus depth, soil characteristics, and other factors associated with forest floor conditions.

During the year, close liaison was maintained with flood-control operations programs now under way on watershed lands of the Yazoo River system (Mississippi) and the Washita River basin (Oklahoma). A field inspection was made of the flood control installations in the Washita basin.

EXPERIMENTAL FOREST DEVELOPMENT

Alexandria

A new area for the Palustris Experimental Forest was located in 1949. The forest is now composed of two separate tracts of 5,800 and 2,030 acres, respectively, both within the Kisatchie National Forest. The smaller tract contains about 700 acres of immature plantations of longleaf, slash, loblolly, and shortleaf pines, and 810 acres of slash pine plantings ready for initial thinnings. Nearly half the larger tract is open, cut-over longleaf land, particularly suited to planting and seeding studies and range research. The balance is scrub hardwoods, scattered second-growth longleaf, and mixed second-growth loblolly, shortleaf, longleaf pines with upland hardwoods.

Birmingham

A set of 1947 aerial photographs was obtained, from which an accurate map of the Flat Top Experimental Forest has been prepared.

The initial cruise indicated that widespread areas had insufficient or no established pine reproduction. Each year since fire protection was instituted in 1946 has shown a steady and rapid increase in pine reestablishment. Now the greater part of the forest has sufficient established pine seedlings to restock the area, even under rather heavy pine or hardwood overstories. This establishment of pine reproduction following fire protection indicates that once fire is excluded--and provided the seed supply is adequate—the problem of getting pine regeneration on similar lands in this territory may become minor.

The general improvement cut was continued. Sixty-one acres were cut over for sawlogs and 105 acres for mine props. Of the material cut, 82 percent was low-quality hardwood, usually unmerchantable outside the mining territory, and 18 percent was low-quality pine, mostly Virginia pine. About 160 cubic feet of saw timber and 120 cubic feet of props were cut per acre, with a total stumpage value of $7.50. Since the material removed would be worthless in many other regions, this cutting continues to indicate the opportunities available within the mining area to make needed stand improvement cuttings at a profit.

Brewton

On the Escambia Experimental Forest, three compartments containing about 31,000, 26,000, and 28,000 cubic feet, respectively, of longleaf and slash pine timber were set aside as natural areas for comparison with managed compartments. Establishing firebreaks through plowing, fertilizing, and seeding showed some promising results. Carpetgrass was effective on slope and swale sites and partially effective on deep sandy ridge sites. Pensacola Bahia grass developed well on slopes, but Dallis grass was a failure.

Crossett

All planned remeasurements of old studies and installation of new studies scheduled for 1949 were completed on schedule. One and one-fourth miles of new road were constructed and gravelled on Unit 2 of the Crossett Experimental Forest. During the year, low-grade and worthless hardwoods were girdled or poisoned on 160 acres of pine land on Unit 1 and on 240 acres of Unit 2. There were no other changes in improvements or facilities in 1949.

Delta

A comprehensive inventory of the Experimental Forest, including growth and mortality data, was completed during the year. Analysis of data is expected to provide a thorough insight into the probable growth capacity of bottomland hardwood stands. A practical grouping of the timber species and forest types characteristic of the bottomland forests has been developed. Fuel wood cutting has been continued.

East Texas

Planned cruising, marking, and cutting were completed on schedule. Guides to the East Texas Branch were published during the year. These describe the Stephen F. Austin and the San Jacinto Experimental Forests and briefly explain the studies under way on the two areas.

Gulfcoast

A freezing rain that began on January 29, 1949, and continued for 2 days destroyed about 4 percent of the pine volume over the entire McNeill Experimental Forest. On one 10-acre compartment thinned in October 1948, 10 percent of the remaining pines were destroyed. The 4-, 5-, and 6-inch trees suffered the heaviest losses--40, 23, and 16 percent, respectively. Only 2 percent of the 10-inch trees were lost.

The first combined thinning and improvement cut in the 18 compartments of the McNeill study was completed in April 1949. A general improvement cut on the remainder of the forest is continuing. Since cutting on the McNeill Forest began in September 1947, the total of all products harvested had reached an equivalent of 2,029 thousand board feet by the end of 1949. The roadside value of these products was $38,500.

Ozark

The Koen Experimental Forest was acquired June 4, 1949. Field work on an inventory of the forest has been completed.

Sales of white oak from the Sylamore Experimental Forest are complete. Approximately 540 thousand board feet of bourbon stave bolts were removed from 2,500 acres. Total receipts were approximately $45,000. The forest has been divided into cutting compartments, and a sale of pine and hardwoods other than white oak has been arranged.

Tallahatchie

An establishment report for the Tallahatchie Experimental Forest on the Holly Springs National Forest has been prepared. Pending completion of formal action on the report, plans for use, development, and protection have been prepared.

COOPERATING AGENCIES

Bureau of Plant Industry, Soils, and Agricultural Engineering

Tree pathology

Fusiform rust of southern pines.--Spray treatments with iron or zinc dimethyldithiocarbamate are highly effective in controlling fusiform rust in the nursery. Tests demonstrated that in such years as 1949 spraying of the burlap under which the seeds are germinating greatly reduces early infection. One or more sprayings should be made before the burlap is lifted if the rust spores infective to pine are abundant at the time of sowing.

Of about 800 slash pine outplanted as cankered seedlings 10 years ago, 99 percent have died, the great majority within 2 years after planting. This calls attention to the need for close culling of infected seedlings at nurseries and planting sites.

Slash pine seedlings that originated from seed from healthy parents continued to show only slightly less infection than those from cankered parents, after 3 or 4 years in the field. The effects of a single prescribed burn in 1946 or 1947 were still apparent in six plots established in slash pine plantations 3 to 6 years old. In all comparisons between burned and unburned plots, the number of new infections (since the date of the fires) was greater in the burned areas.

Earlier studies of weather in relation to rust infection led to the prediction that conditions during late winter and spring of 1949 favored heavy cankering in some localities. This was confirmed by fall examinations in which 20 percent or more of slash and loblolly pine seedlings in some nurseries, and 25 to 30 percent of the trees in young field plantings heretofore relatively rust-free, showed early stages of cankering. Evidence has been accumulating that (1) much of the past damage in heavily cankered stands can be traced to such occasional years of heavy infection as 1949, and that (2) damage usually is heaviest in stands that become severely cankered before the trees are over 5 years of age.

Nursery diseases.--Pilot-plant trials of soil fumigation with ethylene dibromide for root-rot control at the Ashe Nursery demonstrated the practicability of this approach. The increase in plantable seedlings over adjacent untreated areas of slash pine had a calculated value of approximately 10 times the total cost of treatment. An improved applicator, fitted to one of the nursery tractors and operated by the tractor driver, was constructed for regular use at the nursery. Such equipment, plus a probable reduction in the rate of application of the chemical, should further reduce treatment costs.

New chemicals tested this past year included methyl bromide gas, dichlorobutene, and allyl bromide. Methyl bromide was effective in controlling the root disease and gave almost complete control of weeds for the entire growing season. However, it caused severe stunting and some mortality of seedlings, was difficult to apply, and its cost ($400 to $800 per acre) was considered prohibitive. Dichlorobutene and allyl bromide were fairly effective but inferior to ethylene dibromide in disease control.

Longleaf seedlings in pots of sterile soil were inoculated in 1948 with four species of nematodes and three species of fungi, used alone or in various combinations. Final results obtained in 1949 were largely negative, except that each of two species of nematodes caused some root symptoms, such as stunting and darkening, which often have been associated with root rot in the nursery. In no case were the typical red, rough taproot lesions and associated scarcity of lateral roots to be found. A larger inoculation experiment based on the results of the present one was established during the summer of 1949 and will be dismantled early in 1950.

Products pathology

Building decay studies.--Periodic records on a building erected to test the effect of various construction practices on decay in wood siding indicated that:

(1) In walls washed by rain running from roofs, butt joints of siding to trim are very difficult to waterproof by good carpentering and painting. Average moisture contents of wood at joints purposely left open were no higher than those at supposedly tight joints.

(2) Placing trim over siding, usually considered substandard practice, proved effective in keeping the siding dry. Moisture contents high enough for decay occurrence were never reached in siding under trim except during an unusual September squall.

(3) Paper with high vapor resistance placed under siding greatly retarded drying of siding wetted by rain seepage. In contrast, light wind-barrier but vapor-pervious paper permitted about as rapid drying as when no paper was used.

(4) Painting the ends of the siding with oil paint did not appreciably change the rate of water uptake or loss.

The tests suggest that (a) adequate roof overhang is a prime factor in protecting sapwood siding from decay, (b) placing trim over siding is a safer practice than has been supposed, and (c) vapor-resistant papers placed under siding increase the decay hazard, whereas light vapor-pervious papers have little effect on it.

Tests of on-the-job preservative treatments showed that absorptions by pine sapwood during a 3-minute dip in a 5 percent pentachlorophenol-mineral spirits solution (without moisture repellent) were not affected by temperature differences between summer and winter in south Mississippi. Greater absorption was obtained during a period of falling air temperatures than during fairly uniform weather, probably as a result of a mild "hot and cold bath" effect. The common practice of reusing test material in determining preservative absorptions for different immersion periods proved less accurate than the use of separate matched specimens for each immersion period.

Cooperative studies on decay due to condensation in houses without basements were conducted in Oak Ridge, Tennessee, and Charleston, South Carolina.

Control of stain, mold, and decay in green lumber.--Three new proprietary stain-control chemicals were evaluated in several small-scale tests. One product proved unsatisfactory for southern conditions, another of marginal commercial usefulness, and the third of at least equal effectiveness to standard treatments already in use. Manufacturers have withdrawn the first of these from the market and are striving to make the second more acceptable through increased effectiveness.

The previously reported high resistance of stain-control chemicals to leaching was found to apply mainly to wood that is not subjected to rain wash until an hour or more after treatment. All chemicals tested were removed to a significant extent from wood leached shortly after treatment. Presumably, adsorption or change to an insoluble form is needed to render the chemicals resistant to washing by rains.

Pulpwood deterioration.--Following are the results from the study, in cooperation with Gaylord Container Corporation, of deterioration of pulpwood. The wood was cut in July and October 1948 and May 1949 and stored in the mill yard.

(1) For unpeeled slash pine, losses in specific gravity after 4, 6, 9, or 12 months of storage were about 7, 9, 10, and 12 percent, respectively, for July-cut bolts, and 3, 6, 10, and 15 percent for October-cut bolts. It appeared that about 4 months of storage of July-cut bolts and 6 months of storage of October-cut bolts would usually result in rather minor losses. After 6 months of storage, May-cut bolts showed more stain and slightly greater losses in specific gravity than July-cut bolts. Present data indicate that the effect of time of cutting is important largely for storage periods of 6 months or less.

(2) Moisture contents of July-cut and October-cut bolts averaged between 80 and 90 percent after 1 year of storage. Both decay and sapstain usually were most advanced toward the ends of the bolts, which also were the driest parts. Therefore, rapid seasoning as a means of reducing deterioration in unpeeled bolts appeared to offer little promise. In fact, more rather than less deterioration seemed likely from practices that at best could only increase drying rate slightly.

(3) For peeled slash pine, specific gravity losses after 4, 6, 9, or 12 months were about 6, 7, 9, and 9 percent, respectively, for July-cut bolts, and 5, 5, 7, and 7 percent for October-cut bolts. Thus, peeled bolts showed about the same or slightly higher losses in specific gravity than the unpeeled for the first 4 months of storage. They also were more heavily sapstained than unpeeled bolts, regardless of time of cutting or length of storage. However, additional losses in specific gravity after 4 months were minor, so that peeling showed a progressive advantage with longer storage periods.

(4) Moisture contents of peeled bolts dropped to 25 to 40 percent within 4 months for all times of cutting and storing. Such rapid loss of moisture explained why fairly high early losses in specific gravity did not continue with longer storage periods.

(5) Loblolly pulpwood, included only in the May-cut series, showed about the same losses as slash pine after 6 months of storage in the peeled condition. Unpeeled loblolly had more stain and somewhat greater decay and specific gravity losses than any of the unpeeled slash pine groups stored for 6 months. Adequate comparisons between the two species must await later samplings of the May-cut material and other tests in progress.

(6) Analysis of the freshly cut slash pine pulpwood, all obtained from a 22-year-old plantation, showed that (a) specific gravity of the bolts ranged from about 0.38 to 0.61; (b) specific gravity decreased as number of rings per bolt decreased (from the butt toward the top of the trees); (c) moisture content increased steadily as specific gravity and number of rings per bolt decreased (from the butt toward the top of the trees); and (d) bolts from the faster-growing trees in this particular stand averaged as high in specific gravity as those from the slower-growing trees.

Bureau of Entomology and Plant Quarantine

Pine sawfly in southern Arkansas

In the mild winter of 1948-49, eggs of the pine sawfly hatched earlier than has ever been previously recorded. Hatching was first observed on March 7, 1949, reached a peak about March 20, and continued on until about March 28.

Due to the early emergence of larvae, it was expected that feeding would be completed much earlier than normally. However, larvae matured about the time recorded in previous years--around the last week of April. Thus the feeding period lasted a long time. This prolonged period of larval activity exposed the insects to predators, parasites, and insect diseases. Parasitism has been building up for several years and seems now to be reaching a peak.

Defoliation in the spring of 1949 was very light. Timber operators made a survey of the distribution of the sawfly and found that the area of infestation has been reduced. Studies indicate that parasitism reduced the insect population 19 percent and fungus infection reduced it 12 percent. This combined with the mortality from predacious insects and entomogenous fungi is rapidly reducing the epidemic. Observations made during November 1949 show that egg population and distribution are very light and that a further reduction in the sawfly infestation may be expected next spring. It appears now that the insect is fast reaching its endemic status and that damage in the future will probably be very light. However, it will be essential that periodic surveys be continued in order that population trends be observed.

Data on growth loss in trees defoliated by the sawfly show that where the defoliation is virtually complete a loss of growth over 50 percent occurs during the first year of defoliation. Defoliated trees may suffer a small growth loss during the second and third year after the attack.

Powder-post beetles

A large series of treatments was established to determine the value of various insecticides, particularly the new synthetics, in treatments of green wood for the prevention of subsequent beetle attack. Examinations have been made of the 1948 series of tests, in which treatments were applied to control active infestations. Results indicate that infestations varying from very light to heavy attack may be readily controlled with most insecticides in which petroleum oils or other organic solvents are used as carriers.

An important consideration is the residual effectiveness of an insecticide. A chemical which will kill active infestations but will not give protection from future attack is of limited value. To date the 1948 treatments applied for preventing beetle attack have yielded very little information. Some unknown factor has prevented successful establishment of beetles which were liberated on test sections; no infestation has occurred in treated or untreated samples. This experiment will be repeated,with careful control being made of the starch content of samples, beetle populations, and temperature and humidity conditions existing within the test chambers.

Preservation and wood products

A number of additional lumber-dipping tests were made to determine the value of various chemicals in preventing termite attack. These include mainly a few of the most recently developed insecticides.

While certain established chemicals such as copper naphthenate and creosote in kerosene are showing considerable value, there are indications that materials such as DDT and benzene hexachloride may give equally good results when a fungicide is added to the formulation.

It appears quite definite that dip treatments must be given at least a 1-hour exposure to the chemical in order to obtain sufficient penetration for preventive protection on the Gulf Coast. In the Canal Zone, nothing less than a 12-hour dip is satisfactory.

Tests of the resistance of various construction materials to termite attack continue under observation. A number of new materials have been added. These tests have been designed to determine the value of various construction materials containing impregnations of organic and inorganic chemicals, cements, and phenolic resins; plastics are also under test. This work is being conducted in cooperation with housing agencies, the Forest Products Laboratory, and various commercial organizations. It appears that high concentrations of phenolic resins are effective in preventing termite attack. It is questionable, however, whether use of such excessive concentrations would be economical. Treatments in which impregnations of sodium arsenite, pentachlorophenol, copper naphthenate, monochloronaphthalene, and DDT have been made continue to remain effective.

Ambrosia beetles

In studies made from 1946 through 1948, benzene hexachloride emerged as the most effective chemical for the prevention of ambrosia beetle attack on green logs and lumber. In 1949, additional formulations were tested, including several insecticides developed within the last year. Results again indicate that this chemical is outstanding, both from the standpoint of effectiveness and low cost of treatment.

Tests were made to determine the effect of exposure to sunlight, rainfall, and stream wash on the residual duration of various formulations of benzene hexachloride. Sunlight and heavy rain have a tendency to reduce the period over which the chemical is effective. Stream washing has a similar effect. In all cases, the formulation of 0.5 percent of gamma isomer of benzene hexachloride in oil has the greatest residual duration.

Test of equipment and application methods showed that log decks may be sprayed and effectively protected by treatment in their entirety, rather than by spraying individual logs. Concentrated mists or fog sprays are effective and under certain conditions may prove to be much more practical than dilute sprays applied with conventional sprayers. Water emulsion treatments are effective and considerably less expensive than oil formulations but are restricted to use when short-time protection is desirable.

The results of several years' study on this problem have been presented this year in three publications.

Ips and borer control in pulpwood bolts

The 1948 tests on this problem were considerably expanded during 1949. Here again benzene hexachloride gave superior protection, although DDT, Chlordane, Toxaphene, Octachlor, and Octalene offered protection in varying degrees. Under most conditions, a 0.25 gamma concentration offered adequate protection. The treatment, in addition to giving a longer period of effectiveness, is considerably cheaper than the other insecticides. Emulsion formulations were effective, but the duration of effectiveness was not as long as with oil treatments. In the case of the control of active infestations, treatments were far superior to various orthodichlorobenzene formulations which have been used in the past as standard methods of control.

Mist or fog sprays of concentrated solutions have considerable value in preventing attack by bark beetles and wood-boring insects. Their effect in controlling active infestations is questionable. Where proper equipment is used and finely divided sprays are applied, spraying of entire ricks of pulpwood is practical.

This information has been obtained largely from the use of pulpwood-size sections, but the measures will likewise apply to the prevention of attack and control of active infestations in sawlog-size material.

Subterranean termite control

In addition to the large number of formulations installed during past years, newly developed insecticides and certain commercial soil poisons have been added to tests at Saucier, Mississippi. Various formulations of DDT appear quite promising. After 3 years of exposure, benzene hexachloride shows some indication of being a good soil poison. Tests in the Canal Zone established 3 years ago have yet to be examined. Oil solutions of chemicals definitely show better results than water emulsions or water-dispersible forms. A test established in 1944 to determine the value of DDT shows that an 8 percent solution in oil applied at the rate of 1 quart per cubic foot gave 100 percent control. A 4 percent solution gave about 90 percent control. These results are further strengthened by tests which have been in service in Beltsville since 1943.

Tests established in Beltsville and the Canal Zone in 1943 show that a 10 percent water solution of sodium arsenite is definitely the cheapest and most effective soil poison used to date. Its great limitation is its high toxicity to plants and animals. There are many situations, however, in which it can prove valuable.

Analysis of results of soil poison tests conducted in 244 buildings at Fort Bragg, North Carolina, and 22 buildings at Camp Shelby, Mississippi, shows that sodium arsenite is superior. DDT continues to give very promising results when used in oil solutions. A number of previously recommended poisons such as orthodichlorobenzene and creosote solutions are showing failures, both in building tests and in field exposures after 2 or 3 years of service; pentachlorophenol is showing definite signs of weakness in both types of tests.

PLANS FOR 1950

FOREST MANAGEMENT

General

The incorporation of technical comments into the revised text of Technical Bulletin No. 492, "Artificial Reforestation in the Southern Pine Region," will be completed and the manuscript edited for board-of-review action by late spring.

Assistance will continue to the Southern Pine Log and Tree Grade Committee in completing their analyses for recommendation of a set of southern pine log grades. Assistance will also be given in analyzing tree-grade data, but it is not expected that final specifications will be drawn up this year.

The 13-year-old geographic seed-source (loblolly and slash pine) plantations established in cooperation with several southern States will be remeasured during the dormant season and analyses will be made.

Alexandria

Studies of methods required to stimulate early height growth of planted longleaf pine are to be continued. Site preparation and spraying for brown spot control will be tested on a pilot-plant scale.

The study of direct seeding will be continued by observation and analysis of several seeding trials by private landowners.

A plantation survey to determine the correct choice of species for planting sites in southwest Louisiana will be completed.

Pruning in a 15-year-old longleaf spacing plantation will be started this spring as the first phase in a pruning and thinning study. Part of the plantation will be prescribe-burned before treatment in order to continue a series of burns made previously.

A study plan will be developed for testing various alternatives in managing young slash pine plantations.

Birmingham

The exploratory study on improvement of depleted stands by underplanting will be augmented by installation of four variations of the original treatments. These are: (1) commercial improvement cutting prior to planting, (2) improvement cutting above 1.5 inches d.b.h. prior to planting, (3) commercial improvement cutting followed by poisoning undesirable stems above 1.5 inches d.b.h. prior to planting, and (4) poisoning all undesirable stems above 1.5 inches d.b.h. immediately after planting.

Plots have been established for a small study of thinning intensities in young well-stocked pine stands. Costs and returns, growth response, and net yield following three intensities of thinning will be compared.

Additional soil and site samples will be obtained on the Bankhead National Forest until sufficient data have been collected to give good coverage of several levels of site quality. This information will then be examined for the soil characteristics that appear to be associated with particular sites.

The first series of plots designed to test various maximum tree sizes and stand densities will be cut before the growing season. The second replication will be cut in late fall. The improvement cut on the Flat Top Experimental Forest will continue but will be varied to test several rates of conversion on a commercial basis.

Brewton

The final draft of the project analysis on management alternatives for longleaf pine will be completed. Cutting will continue and the logging data will be summarized. Scrub hardwood will be controlled on the cut-over areas. The time of scrub oak control in relation to its effect on longleaf pine regeneration will continue to be studied.

A project analysis on the intermediate management of longleaf pine will be prepared. Data from a series of thinning plots will be analyzed and reported.

Crossett

Installation of the large-scale methods-of-management study will be continued on 40-acre compartments during the year. Two compartments each of the single-tree selection system, the group selection system, and the seed-tree system will be cut. Further information on logging cost, log size, and log grade will be obtained.

The study of the effect which competition for moisture, light, and nutrients has upon the survival and growth of pine seedlings will be reexamined.

A study of the effect of size and age of tree and size and condition of crown upon seed production will be installed. The objective is to provide information that will permit the consistent future selection of good seed trees.

A study of artificial methods of inducing seed production will also be undertaken. Methods will include use of hormones, partial girdling, and tightly banding the tree with wire or metal.

The Forest Survey reinventory of Arkansas Unit 3 is providing special information on the size, quality, and density of low-grade hardwoods now occupying pine sites. Data on the prevalence of pine seedlings and pine trees of seed-bearing size are also being taken. The character and extent of the "hardwood invasion" in southwest Arkansas will be analyzed.

Results of the 10-year reinventory and thinning in the study of the effect of releasing pine reproduction from a relatively low hardwood overstory will be readied for publication.

In 1945, 20 acres of young pine-hardwood stands were given an improvement cutting in which the low-grade hardwoods were removed and, where necessary, the low-quality pine was thinned. The effectiveness of this improvement cutting and thinning in increasing pine growth will be determined by a reinventory during 1950.

The first phase of a study of methods and cost of applying Ammate to kill undesirable hardwoods in pine stands will be completed during the year. A second phase will be installed, using other methods of applying Ammate, including Ammate pellets.

To determine at which season or time of season sprouts resulting from girdling are least vigorous and fewest in number, hardwoods will be girdled every month during the dormant season and twice every month during the growing season.

Installation of a long-range study of the management of upland hardwoods will be completed. Growth and yields of second-growth shortleaf-loblolly pine-hardwood stands are to be determined for (1) southern red and white oak, with pine eliminated, both with and without artificial pruning; (2) mixed pine and oak with no artificial pruning; and (3) pine only with no artificial pruning.

A large-scale thinning study will be installed early in 1950. The object will be to determine if young, even-aged shortleaf-loblolly pine stands should be thinned from above or from below for the greatest quality, volume, and value returns. The effect of carrying various amounts of growing stock will also be investigated.

Remeasurement of the old thinning-study plots at Urania, Louisiana, will be undertaken during the year. Additional thinning will be done if it is necessary, and progress reports will be written.

Delta

Two or three pilot-plant tests of cultivation methods for cottonwood will be established in cooperation with plantation owners equipped for the work. It is expected that this work will finish the cottonwood planting project. All data available will be assembled, and a bulletin on cottonwood planting will be completed.

The tenth-year reinventory of a series of plots comparing various intensities of improvement cutting will be made in 1950, and the data will be analyzed and reported. Initial reports and analysis of the first two plots in sweetgum-water oak stands will be completed.

Following the preparation of a work plan, reproduction quadrats will be established in several forest types. The work plan for a study of the development of sapling, pole, and sawlog-size timber will be prepared in 1950, and initial field work will be undertaken. Field work on three cooperative case studies has been completed. The results to date will be reported during the year.

A bulletin describing the management of bottomland hardwoods will be prepared.

East Texas

Early in 1950, a measurement will be made of sprout development resulting from treating hardwood stems less than 10 inches d.b.h. Number of sprouts and sprout length by species will be recorded for severed, hinged, and girdled trees, and trees treated with Ammate. Pine reproduction will be sampled and height growth recorded. The information gathered since this study on rehabilitation of depleted stands was established will be summarized.

Both the sawlog operation and the pulpwood cutting will be completed in a major study of management of commercial pine stands. An inventory will be made on a portion of the plots after cutting, and cost data on the sawlog and pulpwood operations will be reported. Prescribed burning will be continued as a part of the initial stand treatment. An analysis will be made of 12-year results of growth and mortality of selected loblolly pine trees following various degrees of release. Work will continue on plots established to study the ecological aspects of different silvicultural cutting systems. Cone production will be recorded for selected pine seed trees, and seedfall throughout the study plots will be determined.

The first cut of a pine thinning-spacing study will be made early in the year and the undesirable hardwoods will be girdled.

Methods-of-cutting study plots in bottomland hardwoods will be logged, and data will be assembled on the volume removed and the cost.

The project analysis will be completed on the use of fire in the management of shortleaf-loblolly pine-hardwoods type. The brush and hardwood control study plots on the Sam Houston National Forest will be burned this spring, summer, and winter. A progress report will be written on results of the first spring burn. The effect of intensity and number of burns on species by size classes, seedbed preparation under varying amounts of litter accumulation, plant succession on various sites, site and soil composition, and on hazard reduction under various overstories will be considered for study.

Gulfcoast

Three compartments in commercial longleaf-slash pine stands on the McNeill Experimental Forest will be cut for the second time. Exploration of the possibility of reforesting small swamps and creek bottoms with pine will be continued. Cutting and cost data will be compiled. A manuscript will be prepared on the response of longleaf seed trees to release.

Data will be analyzed and a report made on fuel measurement in the longleaf pine type. Studies on relation of scorch to mortality and growth will be remeasured and data analyzed for publication. Study of the fire resistance of longleaf pine in relation to age will continue and be reported.

The second field planting and third nursery installation of the longleaf pine seed-source study will be made. Work on fertilization and quality of longleaf seed trees, effect of fire in site preparation, and stimulation of height growth by burning will continue. Data from the 1948 pre-seedfall burning test will be analyzed. Field tests of physiological grades, Ashe Nursery plantations, post-planting nutrition, and bar-planting nutrition will be continued.

A final report on the Ashe Nursery project will be prepared in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering. Other reports to be written include the sawdust compost tests, site preparation, fire effects, pre-seedfall burning, and seedling nutrition as affected by burning or spraying. Additional studies planned are fertilization of natural stands; effects of ringing and turpentining on longleaf seed production, seedfall, and dispersal; and effects of growth regulators on height growth of longleaf seedlings.

Ozark

Stand and yield tables for eastern redcedar will be assembled. The possibility of publishing a bulletin for use by farmers and others interested in growing redcedar is being considered. A report will be made on the effect of chemical control of upland hardwood weed trees. A study of various intensities of improvement cuttings in cull stands of upland hardwoods will be installed.

A study of stand structure and its effect on growth of white oak will be fully established before the spring growing season. Analysis of data from natural-growth plots will be completed.

A project analysis on the planting problem will be made. Approximately 13 acres will be planted, using seven conifers and three hardwoods on each of three sites.

Compilation of data from the inventory of the Koen Experimental Forest and the preparation of base and soils maps will be completed. On the Sylamore Experimental Forest, marking and tree measurement of pine and hardwoods other than white oak will be continued in cooperation with the Ozark National Forest, and a plan will be written for continuing the timber stand improvement work.

Tallahatchie

A test of generally accepted methods of gully control will be installed in cooperation with the flood control action program of the U. S. Forest Service and the Soil Conservation Service. Seasonal observations of grass and legume test plantings will continue and results to date will be reported. Additional data will be taken on a comparison of important characteristics of the seven principal soils of north-central Mississippi and western Tennessee.

Information obtained from detailed Forest Survey data will be used to summarize the principal problems throughout the territory and to point up needed studies. Pine underplantings, released by girdling or poisoning, will be remeasured and summarized. Additional plantings will be established. Loblolly pine and hardwood underplantings on fair to good sites will be remeasured and additional plots will be installed. Underplanting with redcedar will be tested by establishing a series of plots.

Farm Forestry Research

Alabama

Case studies of three or more pilot-plant farms will be initiated in cooperation with individual farmers to determine the effects of forest management on returns from the entire farm operation. Both beef and dairy farms will be compared with a cotton farm to determine the part the farm woodland plays in each of these types of farming and to which type the woodland can make the greatest contribution.

Mississippi

A cottonwood plantation established in cooperation with the Mississippi Agricultural Experiment Station will be reexamined and survival and growth will be reported. Work will continue on the Newton County farm forest unit, and another unit will be established, though the location has not yet been determined.

FOREST ECONOMICS

Forest Resources

Timber resources of Tennessee and Arkansas.--The Southern Forest Survey's initial field inventory of forest areas, timber volumes, and growth for the State of Tennessee will be completed this year. A statistical report will be published on the western and central regions of the State. Work will be started on a State statistical report to be published as a Forest Survey Release in 1951.

In Arkansas, field work on the unsurveyed central and northeastern portions of the State will be resumed by the Forest Survey during the latter part of 1950. A statistical report on the southwestern counties, which were recently resurveyed, is planned for mid-1950.

Analysis of forest situation.--A comprehensive report on the forest situation in Mississippi--summarizing data about the forest and explaining the situation in terms of forest-products industries, forest landownership, and other factors bearing on the timber resource--will be prepared in 1950. This report is intended for publication by the Government Printing Office.

With Forest Survey field work in process both in Tennessee and Arkansas, intensive preparations will be made in 1950 for comprehensive reports on the forest situation in these States.

Estimating cull in standing timber.--The study to develop a method that Forest Survey timber cruisers can apply in estimating cull in southern hardwoods will be continued.

Land use in southwest Louisiana.--The manuscript "Planted pines and cattle grazing--a profitable use for southwest Louisiana's cut-over lands" will be made ready for publication.

Characteristics of east Texas small-woodland ownership.--A field survey of farm woodlands in Nacogdoches County, Texas, will be made by the East Texas Branch to determine (1) the condition of forest land, pattern of ownership, management practices, methods of marketing and processing forest products, and costs and returns from woodlands; and (2) what are the major factors interfering with abundant output and income from east Texas woodlands.

Forest Industry

Work on the forest industry and drain phase of the Forest Survey will be centered in Tennessee in 1950. The Station will make canvasses of wood-products output by primary timber-using plants, and of the production of hewn railroad ties, poles, piling, posts, and round or split products for mine and domestic use. A survey of logging operations will also be made, to obtain factors for converting wood-production data into terms of drain on standing timber.

Logging methods, equipment, and costs.--The Birmingham Branch will study costs of various methods of producing mine props.

At the Crossett Branch, a check of the cost data obtained on the long-length logging study will be made at one or more lumber company operations in south Arkansas.

Hardwood utilization.--At the East Texas Branch, the study on utilization of low-grade southern red oak, post oak, and sweetgum will be continued. Information developed thus far will be tested under pilot-plant conditions. At the present stage of this study, the Forest Utilization Service is playing the most prominent part in discharging the responsibilities of this Station.

Marketing and Prices

The Birmingham Branch will complete a survey of log and bolt users and processors and the grades of timber they use for various products. Grades actually used and minimum specifications that are satisfactory to users will be analyzed in an effort to throw light on the question of utilization efficiency.

A survey of market outlets for forest products will be made at the Ozark Branch.

Economics of Forest Management

Guides to profitable forest management.--During 1950, additional studies will be made under this project to help the forest owner or manager arrive at profitable management decisions. These studies will include:

(1) A guide to financial maturity of bottomland-hardwood saw timber and of shortleaf and loblolly pine saw timber.

(2) A guide to profitable conversion--all-aged versus even-aged management--of loblolly-shortleaf pine-hardwoods.

(3) A guide to optimum stocking of pine-hardwood stands under selective management.

(4) A guide to profitable improvement cutting in the hardwood-pine forests of north-central Alabama.

Returns from well-managed commercial forests.--Costs and returns from the selectively managed 1,000 acres of shortleaf-loblolly pine-hardwoods at the Crossett Branch and from the section of managed longleaf pine at the Brewton Branch will be reported. A progress report covering 10 years of management on the 1,000 acres at the Crossett Experimental Forest will be completed for publication.

Returns from well-managed small tracts.--Studies of the financial possibilities of small woodlands will be continued at six branch stations during 1950, and will be started at a seventh—the Ozark Branch. At most of these branches, field days will be held on experimental forests in order to show woodland owners what products can be cut annually under intensive management. Records of costs and returns will be released, and methods of managing and harvesting timber will be demonstrated on the ground.

Large versus small products in selective timber management.--This study, at the Crossett Branch, deals with the quantity and quality production that can be obtained from stands managed selectively for small products such as pulpwood and small logs, as contrasted to large, high-grade sawlogs. The study will be completed for the present 5-year period. A light growing stock of 1,200 cubic feet per acre will be maintained on one set of plots. Results will be compared with those obtained on other plots carrying 1,700 cubic feet of growing stock.

RANGE RESEARCH

Alexandria

Grazing management.--A technical article will be prepared on seasonal herbage production of forage on open forest range. The article will be based on the measurements taken in 1947, 1948, and 1949. A field handbook of important forage plants will be worked into a manuscript with help from the New Orleans and Washington offices. The changes in herbage production under five intensities of hardwood control will be remeasured in August 1950, three seasons after treatment. By then, the main increase in forage production that results from hardwood control should be reached. A progress report will be prepared; the study will continue for several years.

A plan to study yearlong versus seasonal grazing of forest range by beef cattle will be completed early in 1950. Ground plans and necessary range pasture inventories will be made on the new experimental forest tract. During the year, efforts will be made to arrange for facilities, a cooperator, and beef cattle herds for this important study. Early in 1950, the final office report will be completed on the study of feeding winter supplements to forest range cattle, and, if results warrant, manuscripts for publication will be prepared. Under the study of hogs on forest range, a pictorial leaflet describing hog damage to pine trees will be published. Grazing-damage surveys on planted slash pine will continue, to determine the residual effects of 1949 grazing as well as to measure second-year grazing damage.

The original study plan on chemical control of hardwoods has been fulfilled. A paper reporting final results will be published in 1950. Future research in chemical control of hardwoods will be conducted under a new study. Emphasis will be on finding more effective and cheaper chemicals, and on developing safer and cheaper methods of application than those now in use.

The field work has been completed on the study of improvement of summer and fall grazing. An article presenting final results will be written. Two new studies on methods of improving the forage on forest ranges will be established. The first will attempt to determine whether an effective firebreak can be created and maintained by seeding, fertilizing, and grazing. Several forage species, fertilizers, and site preparations will be tested. Cattle grazing will be controlled as needed to obtain close utilization. Mowing, fertilizing, and other treatments will be applied as necessary to maintain the firebreak vegetation. The relative costs of seeded and fertilized firebreaks and of plowed firebreaks will be evaluated.

The second study involves nursery trials of promising forage species for ranges. A small nursery will be established for testing selected grasses and legumes for their suitability for vegetative firebreaks and for improving the forage on forest ranges. Plants that have proven valuable in tests conducted by other agencies in other parts of the South will be selected.

Brewton

The working plan will be completed for the study of forage production as related to tree stands, and field records will be continued. A study will be started to determine the extent that cattle graze poisonous plants on forest range. Records will be continued on the seeding and fertilizing tests made in 1948 on the firebreak study.

East Texas

An exploratory study of the status of forest grazing in east Texas will be started.

Gulfcoast

The study of season-of-grazing in well-stocked longleaf pine stands is scheduled to get under way in March in cooperation with the Mississippi Agricultural Experiment Station. Four 160-acre experimental pastures will be stocked with yearling steers. Cattle weights will be taken and records of forage production and utilization will continue. Results of the study of sheep-grazing damage will be published.

Collaboration will continue with the Bureau of Plant Industry, Soils, and Agricultural Engineering on the testing and selection of grass and legume species adapted to southern forest range conditions.

Ozark

Field measurements will continue on the study of forage production in upland hardwoods. Fifth-year remeasurements will be made of permanent deer-forage plots.

FOREST UTILIZATION SERVICE

A final report on the cooperative wood waste study will be prepared. A considerable amount of incidental but very worthwhile and timely data is being developed in connection with the waste study. Station papers will be prepared to make these data available to the public.

The cooperative low-grade hardwood utilization study in east Texas will be continued. It is anticipated that additional work of this nature will be carried on at the Birmingham and Ozark Branches. The work in log grade schools will be continued, with emphasis placed on training industrial foresters in Texas, Louisiana, and Mississippi. The mill scale-grade yield recovery study that is being conducted cooperatively with the Tennessee Valley Authority will be continued and expanded to the analysis and reporting phase.

The cooperative study with the Forest Products Laboratory and the Tennessee Valley Authority will continue the investigation of wood molasses as a food for livestock. In 1950, some feeding tests will be carried on in States west of the Mississippi.

A study of the effect of flat piling and mechanical handling of lumber in unit packages will be made in cooperation with the Forest Products Laboratory. The kiln-drying work at Mississippi State College, using the Forest Products Laboratory's pilot kiln, will be continued for species of hickory and oak. Assistance will be extended to the Tennessee Valley Authority in air-seasoning and kiln-drying studies to be initiated this year.

A tentative plan for the study of the factors affecting the density of southern pine pulpwood has been submitted to the Forest Products Laboratory. It is hoped that this study can be started in 1950.

FLOOD CONTROL SURVEYS

Survey plans for 1950 are: (1) to complete the Homochitto-Buffalo River survey and report and expedite regional review by Federal and State agencies; (2) complete most of the field work and data analysis for the Ouachita survey; (3) prepare forestry recommendations and report contributions for current Soil Conservation Service surveys, including those for the Lower Red, Trinity-San Jacinto, and the Apalachicola-Altamaha Rivers; and (4) complete major revision of a number of survey reports, including the Station's Upper White River report and various Soil Conservation Service projects (Lower Arkansas, Pee Dee, and Grand-Neosho River watersheds). The schedule for 1950 also includes the advance planning and initiation of a survey of the Tippah River watershed (Tennessee).

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1949

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THIRTIETH ANNUAL REPORT

1950

SOUTHERN FOREST EXPERIMENT STATION
Chas. A. Connaughton, Director
New Orleans, La.

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THIRTIETH ANNUAL REPORT

SOUTHERN FOREST EXPERIMENT STATION

1950

During 1950, the Southern Forest Experiment Station took several steps toward providing an adequate technical base for southern forestry. For the first time, a publication is available on the management of bottomland hardwoods. It is not the final story, but it fills for the present a great gap in American forestry literature. A bulletin describing and illustrating the various hardwood log defects was also issued. Together with other information, this bulletin has been used for numerous training schools in the use of hardwood log grades. Meeting the demand for these schools and for other extension of information on hardwood log quality has involved a big job during the year.

A start was made in forest genetics research. A program of study has been drawn up and field work is under way. The Station has also begun to devote more research to basic soil characteristics and to the ways in which variations in soil affect tree growth and forest management. While both genetics and soils studies have a long road to travel, the initiation of the work marks a new direction in our research program.

A fully formed project was developed during the year on the place of fire in the shortleaf-loblolly pine-hardwoods type. The scope of the investigation will expand as results accumulate.

Among the Station's major contributions during the year were methods for evaluating various alternatives of management. Attention was directed particularly at methods of calculating the optimum growing stock and the maximum size to which trees should be grown. The work applies to both the pine and the bottomland hardwood forests.

The Forest Survey for Tennessee was completed. Final statistics will be available early in 1951. The second survey of Arkansas is progressing, and we expect to complete field work by mid-year. A flood control survey for the Upper White River was finished. Other surveys were started in conjunction with the basin planning project recently undertaken for the Arkansas-Red-White River drainage area.

Forage values and uses in Louisiana and Mississippi were studied further. Particular emphasis was placed on completing a publication to show how grazing and timber growing can be integrated in southwest Louisiana's cutover lands, and the economic returns to be expected from such integration. The publication is due in mid-1951.

A report was issued on wood waste at southern pine sawmills. The report was concerned primarily with the amount of waste that can be converted to pulp chips.

Many other studies, the results from which are briefly stated in the following pages, were in progress. Regrettably, the report on the comprehensive analysis of southern pine planting was not issued in 1950. It is expected, however, that a processed version will be available for limited distribution during the coming year.

As for the future, the national defense program will certainly occasion some changes in research effort. We anticipate, however, that long-time studies of basic importance to efficient forest land use will be maintained. Further, we expect a demand for short-time studies and surveys to meet the exigencies of the moment. Harmonizing these features of the research program with available funds and personnel will constitute the main problem in research administration during 1951.

RESULTS

FOREST MANAGEMENT
(Including Forest Influences)

Regeneration

Nursery practice

Nursery conditions have a strong influence on the survival of outplanted longleaf pine seedlings. As yet, it is not known whether climate, fertilizer, seedling density, soil, or watering differences cause differences in survival, but for 2 successive years longleaf 1-0 stock from the Alabama State Nursery at Autaugaville has survived better than stock grown from the same seed sources at the Harrison Experimental Forest nursery at Saucier, Mississippi. First-year survival in 1949 is given in table 1.

Table 1.--First-year survival of longleaf seedlings, 1949

Outplanted	Harrison nursery	Alabama nursery
	- - - Percent	- - -
Mississippi	52	87
Alabama	41	75

Stock from the same two nurseries planted in Mississippi in 1950 survived much better than in 1949; but 94 percent of the seedlings from the Alabama nursery showed good or excellent vigor, while only 78 percent of the seedlings from the Mississippi nursery attained that rating. The moral is to know your nursery and secure as much planting stock as possible from nurseries with good performance records in the area where the outplanting is made.

Direct seeding

A large acreage of pine forest land in the territory of the Southern Forest Experiment Station is without a pine seed source. Despite private, State, and Federal reforestation programs, 50 years will be needed at the present rate of expenditure to plant former pine lands now poorly stocked. Cheaper reforestation methods might speed this process up.

Direct seeding after burning or disking has given satisfactory stands of both slash and longleaf pines at Alexandria, Louisiana. The burning or disking improves the seedbed, lessens first-year grass competition, and destroys cover which harbors seed-eating rodents. At least 15,000 seed per acre (not less than 60 percent viable) should be broadcast-sown early enough to insure fall germination. In one instance, longleaf pine was direct-seeded for little more than one-third what planting would have cost. Of course, drouth, rodents, or birds can cause failures much more frequently than with plantations, so, in the long run, the total cost of securing a stand may be considerably increased by the necessity of resowing.

Underplanting

Three years of underplanting in central Louisiana has demonstrated that areas of scrub oak can be successfully converted to loblolly and slash pine provided that the planted pine is released at the time of planting or soon thereafter. Survival and growth of pine seedlings have been better than on open sites, but costs have also been greater. Plantations on open grasslands were almost total failures after a first-season drouth, while released plantations in scrub oak were successful. As might be expected, deferring release after the time of planting reduced both survival and height growth. Three years after planting, an examination disclosed 86 percent survival and 4.3 feet average height for initially released loblolly pine, but only 33 percent survival and 2.2 feet average height for unreleased loblolly. The corresponding figures for slash pine are 46 percent survival and 3.4 feet average height for released trees, and 27 percent survival and 1.6 feet average height for unreleased trees. Underplanted longleaf was showing a similar trend until hogs destroyed it.

Underplanting tests with six conifers are being conducted under poor upland hardwoods in north Mississippi. Part were released at the time of planting and part have been left unreleased. Second-year survival has been good for both released and unreleased plots, but the released seedlings have made nearly twice the height growth (table 2).

Table 2.--Second-year survival and height growth of conifers planted under low-grade hardwoods in north Mississippi

Species	Released		Unreleased	
	Survival	Height	Survival	Height
	Percent	Inches	Percent	Inches
Loblolly pine	87	35	93	18
Virginia pine	70	34	82	19
Slash pine	48	30	59	15
Shortleaf pine	74	20	79	10
Eastern redcedar	56	12	76	8
Longleaf pine	41	.6	40	0

All species but longleaf pine and redcedar have been attacked by the pine tipmoth (Rhyacionia frustrana) and by the pine webworm (Tetralopha robustella) (table 3). The taller (released) trees were hit hardest by the tipmoth, while the less vigorous (unreleased) trees were more heavily damaged by the webworm. No one knows why slash suffered damage, as it is usually immune.

Table 3.--Percent of living underplanted seedlings damaged by insects

Species	Released		Unreleased	
	Tipmoth	Webworm	Tipmoth	Webworm
Loblolly	64	0	29	14
Shortleaf	21	4	3	14
Slash	7	0	4	3
Virginia	56	0	21	15

Although there has been a tendency to favor conifers and discourage low-quality hardwoods on the upland sites, the possibility of underplanting hardwoods of valuable species under the low-quality hardwood overstory is not being overlooked. In north Mississippi, second-year survival of underplanted yellow-poplar, black locust, white ash, black walnut, and white oak has averaged 84 percent. Except for black walnut and white oak, released hardwood seedlings averaged 2 to 4 times as tall as unreleased seedlings (table 4). Released yellow-poplar and black locust averaged taller than released loblolly pine that had been underplanted on the same areas. Moreover, few hardwood seedlings have suffered damage by insects or other agencies.

Table 4.--Average height of underplanted seedlings after two growing seasons

Species	Released		Unreleased	
	Survival	Height	Survival	Height
	Percent	Inches	Percent	Inches
Yellow-poplar	86	46	98	11
Black locust	79	53	70	16
White ash	97	22	98	10
Black walnut	76	19	80	19
White oak	82	13	84	12
Loblolly pine	79	37	85	13

In south Alabama, underplanted longleaf pine seedlings showed an immediate growth response when the scrub oak overstory was poisoned with Ammate. Second-year diameter growth of seedlings released at 1 year was 0.15 inch, as compared to a diameter growth of 0.06 inch for unreleased seedlings.

At Birmingham, Alabama, loblolly pine was planted under low-grade hardwoods. Several different methods of cutting or poisoning, or both, were tested, with commercial cutting preceding planting to avoid logging damage to planted stock. The debris from logging conducted before planting increased planting labor cost by 35 percent, so that it probably would have been preferable to plant cheaply before logging and to suffer whatever damage logging might inflict.

The species most resistant to Ammate poisoning for the 6 months following planting was mockernut hickory (Carya tomentosa).

In order to ascertain how late loblolly pine seedlings could be planted in central Alabama with hope of reasonable survival and height growth, groups of 100 trees were planted from time to time, starting with mid-March and terminating in June. Height growth and survival fell off rather badly on seedlings planted after April 24, while survival continued to become worse as the date of planting was postponed (table 5). Seedlings were stored in a heel-in bed until they were planted; when growth of the heeled-in seedlings accelerated, the success of planting began to diminish.

Table 5.--First-year growth and survival of late-planted loblolly pine nursery stock near Birmingham

Planting date, 1950	Survival, Dec. 1950	Average height, Dec. 1950
	Percent	Inches
March 17	93	14.1
April 11	82	13.8
April 24	81	13.6
May 8	69	11.3
May 22	57	11.4
June 5	23	11.2

Reduction of mortality in field-planted longleaf pine nursery stock

A small study in south Mississippi tested two methods of reducing transpiration of outplanted longleaf seedlings. It was found that clipping one-third or two-thirds of the needle length before outplanting decreased mortality (table 6). Top-dipping of the seedlings in lanolin or trademarked Dowax emulsion before planting also decreased mortality. Clipping and dipping combined resulted in the best early survival on an adverse site.

Table 6.--Survival of longleaf pine seedlings, 36 days after planting on a dry, sandy site, Harrison Experimental Forest, 1950

Dipping treatment	Proportion of foliage tuft removed			
	0	1/3	2/3	Average
	- - - - Percent surviving - - - -			
Not dipped	19	22	37	26
Dowax	82	83	87	84
Lanolin	62	63	74	66
Average	54	56	66	59

Machine planting of longleaf pine

Further results from a cooperative test of machine planting installed in the Leaf River District by the Mississippi National Forests in January 1949 show that first-year survival of large machine-planted longleaf seedlings is slightly lower than survival of small and medium seedlings (table 7). When buds of the seedlings were buried, survival was not as good as when the seedlings were planted too shallow. In this test, medium-sized seedlings appeared to stand incorrect planting better than either large or small seedlings. Large seedlings did show promise of better vigor later on, which might more than compensate for their lower early survival.

Table 7.--Effect of size of stock and type of planting on first-year survival of machine-planted longleaf pine seedlings

Type of planting	Large stock (0.31-0.50) 1/	Medium stock (0.19-0.28) 1/	Small stock (0.12-0.19) 1/	Average
	- - - - - Percent surviving - - - - - - -			
Planted too shallow	79	88	84	83
Planted too deep	60	77	78	77
Planted right	83	89	94	89
Average	81	88	89	88

1/ Range of root collar diameter (in inches).

Cottonwood planting

Several small tests of the use of machinery in site preparation and in cultivation of cottonwood plantations the first year after planting were conducted in the Mississippi Delta during 1950. Results confirm that the use of machinery is entirely feasible, and much less expensive than hand methods.

Site preparation of abandoned submarginal agricultural land with a ground cover of weeds but with few woody sprouts can be satisfactorily accomplished by disking the entire area in two directions, using a large wheel tractor and an ordinary two-row disk harrow. The cost is about $2.00 per acre. The necessary first-year one-directional cultivation of the cottonwood plantation in late May and early July can be accomplished with the same equipment at about the same cost as the preplanting disking. In addition to this machine work, a small amount of hand hoeing needs to be done at the time of the second cultivation in order to release the trees not adequately freed by disking.

Total cost of establishment and first-year care of a cottonwood plantation on abandoned land that is free of heavy woody stems is approximately $13.00 per acre. These costs are based on machine and labor rates prevalent in the Delta during the 1949-50 season. Costs per acre were as follows: site preparation $2.00, planting stock (9 x 9-foot spacing) $1.60, planting $2.20, machine cultivation $2.05, and hand hoeing $5.00.

For planting sites covered by a dense growth of vines, shrubs, and woody sprouts, the use of 5-foot-wide planting strips prepared by a heavy four-disk fire-line plow is still the best practice that has been tried. Establishment and necessary first-year care of a cottonwood plantation on these rough planting sites was approximately $23.00 per acre at 1949-50 rates. These costs include the preplanting removal of down trees and debris from the strips at $3.80 per acre, plowing of planting strips $8.15, planting stock (6 x 10-foot spacing) $2.15, planting $2.20, and post-planting cultivation $6.85.

Cost of producing cottonwood cuttings

After four annual harvests, the 40 x 12-inch spacing is still producing the greatest number of plantable 20-inch cuttings at the Delta Experimental Forest cottonwood nursery. To date, 102,000 cuttings per acre have been produced and two more crops totaling approximately 50,000 cuttings per acre can be harvested before the cutting material will be too large in diameter for practical use. On this basis, cost of cuttings will be less than 50 cents per thousand, exclusive of harvesting, transportation, trimming, or storage costs.

Stimulating early height growth of planted longleaf pine

Preliminary results from 2-year-old longleaf pine plantations established in central Louisiana to develop practical methods of stimulating early height growth of planted longleaf pine seedlings indicate that site preparation practices such as burning, disking, and plowing have not, as yet, significantly improved the survival or growth. Survival ranged from 68 to 90 percent for all treatments, including undisturbed old roughs. Heavy precipitation during the last two growing seasons, however, may have influenced the results. It is possible that site preparation will prove beneficial in normal or drought years.

Application of commercial fertilizer also has been ineffective. It stimulated the growth of weeds and grasses which, in turn, have suppressed the growth of the pine. Spraying the seedlings with Bordeaux mixture during the second growing season has given good brownspot control. The use of Fermate spray the first year was unsatisfactory.

Silviculture

Timber stand improvement in southwest Arkansas

Detailed consideration of the low-grade "hardwood invasion" on the pine sites of southwest Arkansas is possible for the first time from data obtained during the recent Forest Survey. The area surveyed contains nearly 5 million acres of potentially highly productive pine land. The survey indicates that 45 percent of this area is adequately stocked with pine; 33 percent is inadequately stocked with pine but possesses an adequate seed source; and the remaining 22 percent (over one million acres) has neither adequate pine stocking nor an adequate pine seed source. Here a combination of timber stand improvement work along with planting or direct seeding will be necessary to establish or bring back a good pine stand.

Not all the hardwoods found in the pine stands are low-value species requiring elimination. The total cubic-foot growing stock (pine plus hardwood) includes 7 percent sweetgum, 9 percent red oak (southern red, cherrybark, black, shumard, or scarlet), and 4 percent forked-leaf white oak.

Choice individuals of some of these potentially valuable species should be saved and grown with the pine. However, 14 percent of the total cubic volume of hardwood now present in the stands is cull, and 76 percent of the log-size material is of the lowest grade. Thus very few of the hardwoods present are of desirable species or quality. The others cannot hope to compare favorably with pine on the basis of potential earnings.

Classification of hardwoods dominating the inadequately stocked 55 percent of the area gives a clue to timber stand improvement measures needed. Hardwoods larger than 2 inches d.b.h. dominate 86 percent of the area, and only 6 percent is entirely free from any hardwoods. Fire cannot be used effectively on these larger hardwoods, so commercial cutting, girdling, or poisoning is the only recourse (coupled with planting on 40 percent of the area), if full productivity is to be realized.

Studies at Crossett have rather fully explored practical local application of hardwood control measures. In 1950, 5-year periodic growths were compared from two initially similar second-growth shortleaf-loblolly pine-hardwood stands, one of which has remained uncut and the other of which received a combined commercial and non-commercial improvement cutting and thinning in 1945. In the treated stand, defective, crooked, and knotty pines were cut (plus any others needed to open up dense clumps), while all hardwoods larger than 3.5 inches d.b.h. were cut for sawlogs or chemical wood, or girdled if unmerchantable. In addition, 45 smaller hardwoods that were suppressing pines were cut on each acre.

Over the 5-year period, the treated stand had a 29 percent greater cordwood growth and a 21 percent greater board-foot growth than the uncut stand (table 8). This indicates that deferring the stand improvement job reduces per-acre returns in a relatively short time.

Table 8.--Effect of improvement cutting in second-growth shortleaf-loblolly pine-hardwood stands upon pine growth

Treatment	1945, after treatment	1950	5-year growth
	- - - - Rough cords[1] - - - -		
Cut	10.9	17.2	6.3
Uncut	16.1	21.0	4.9
	- - - - Board feet[2] - - - -		
Cut	2,678	4,374	1,696
Uncut	3,255	4,624	1,369

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[1] Trees larger than 3.5 inches d.b.h., including sawlogs.

[2] Trees larger than 9.5 inches d.b.h., International 1/4-inch log rule.

Timber stand improvement in the Ozarks

In 1935, the Ozark National Forest in northern Arkansas carried out an extensive timber stand improvement job on upland hardwoods of the Sylamore Ranger District. Cull trees overtopping desirable smaller stems were girdled, except that white oak, walnut, and ash were always left as seed sources. No cull trees were girdled unless they were interfering with more desirable stems. Fifteen years later the treated areas have 119 desirable stems per acre in the 1/2-inch to 7½-inch d.b.h. group (with a basal area of 7.3 square feet per acre), while untreated areas have only 56 desirable stems per acre in the same d.b.h. group (basal area, 2.8 square feet per acre). This timber stand improvement was carried on in a poor-quality, essentially single-storied stand. It is apparent that intensive forestry in such stands is not as attractive as in all-aged stands,or as in pine or bottomland hardwood areas, but it is also evident that conversion to a better grade upland hardwood stand will probably never take place unless the cull overstory is at least partially removed. Removal of a larger portion of the undesirable overstory would, of course, speed up the conversion, but returns from such treatment will be long deferred.

Chemical control of undesirable hardwoods

Timberland owners have the tremendous job of removing or reducing cull and low-quality hardwoods on millions of acres of pine and potential pine land throughout the Southern Station territory. Because of this and because there is a wide variation in the hardwood and pine species involved, and in site, soil type, and growth possibilities, great interest in the cheapest and best methods and means of hardwood control continues through the region. Consequently, some work of this nature is in progress at all the branch stations.

In east Texas, low-grade hardwoods in pine stands were treated by (1) standard two-hack girdle, (2) felling or hinging so that the tree is not completely severed from the stump, and (3) poisoning with Ammate in low cups or gashes. Two and one-half years after treatment, the two-hack girdle is nearly as effective in killing crowns of hardwoods 4 to 8 inches in d.b.h. as Ammate in cups, but Ammate reduces sprouting and hastens top killing. Sprouting of hinged, severed, and girdled hardwoods decreased as tree size increased; 86 percent of the trees below 4 inches sprouted, but the sprouting of trees above 10 inches was negligible. Treating all hardwood stems 1.5 inches d.b.h. and larger proved undesirable where pine was not well enough established to take advantage of the space thus released, since hardwood seedlings and regrowth 2 years after treatment were extremely dense, even where Ammate was used to reduce sprouting. Under such conditions, it is doubtful whether pine reproduction less than 3 feet tall will survive or whether new seedlings can become established.

In another study in east Texas, the effectiveness of applying Ammate in cups 3 feet above ground level rather than at ground level was tested on post oak, red oak, and sweetgum 2 to 7 inches in diameter. Trees were treated during alternate months over a period of a year. The crown kill of post oaks and red oaks treated at ground level was about 30 percent greater than for those treated 3 feet higher. Crown kill on sweetgum was nearly 100 percent for both treatments. Sprouting was much greater where the trees were treated at a convenient chopping height than where treatment was at ground level. There was little correlation between mortality and season of the year at which Ammate was applied. Larger trees were more difficult to kill than small ones but sprouted less.

In north Mississippi, Ammate in cups at ground level was tested against a single-frill girdle on miscellaneous sizes and species of upland hardwoods ranging from 1 to 8 inches in d.b.h. Crowns of 69 percent of the poisoned trees were more than two-thirds dead after 1 year; after the second year 77 percent of the trees had crowns more than two-thirds dead. The single-frill girdle caused only 54 percent of the trees to suffer more than two-thirds crown kill after the first year, but appeared to better advantage after the second year, when 94 percent of the single-frilled trees had crowns more than two-thirds dead. Where sprouting is no consideration, frilling appears to be less expensive than poisoning, and more effective in killing the crowns. White oak and hickory resisted poisoning the most stubbornly.

Three years after treatment of a large number of low-grade hardwoods at Crossett, Arkansas, Ammate crystals in cups at ground line appear to give a fairly satisfactory crown kill with almost no sprouting when used on hardwoods 9 inches in d.b.h. and less. Ammate crystals in cups at 30 inches also gave a fairly satisfactory crown kill with almost no sprouting when used on hardwoods 6 inches in d.b.h. and less. When applied in a frill, both a 19.3 percent and a 37.5 percent solution of Ammate gave a very satisfactory crown kill on all-sized hardwoods and reduced the size of the ensuing sprouts by 25 to 50 percent. The 19.3 percent solution is cheaper and just about as effective as the 37.5 percent solution. Frilling alone, when carefully done, will result in a good crown kill on trees 9 inches in d.b.h. and less. Conclusive information on the success of killing larger trees in this way is lacking. The use of Ammate on trees 10 inches in d.b.h. and larger is undesirable. Trees of such size should be girdled; girdling of smaller trees will also be effective where sprouting may be tolerated.

The use of the Ammate cup-crystal method is rarely justified economically except where small seedlings (less than 3 feet tall) are to be released from numerous small hardwoods, as in scrub oak conversion by underplanting. Two-hack or notch girdling (to insure cambium ringing) appears to be economically best for killing most species of upland hardwood trees larger than 9.5 inches in d.b.h., while frilling or severing followed by a 19.3 percent Ammate solution appears to be the best way to handle trees smaller than 9.5 inches d.b.h., except where maximum sprout control is needed. Simple frilling would probably be satisfactory on all sizes of trees, except that crews are often careless and fail to ring the cambium completely, in which case the weak Ammate solution may still kill the tree. At all events, the solution is cheap and reduces sprouting somewhat.

Management of commercial stands

Shortleaf-loblolly pine-hardwoods.--In east Texas, a large-scale study of yields, costs, and returns from six methods of management is well under way. It includes (1) an all-aged selection system (5-year cutting cycle) and five even-aged systems, (2) strip clear-cutting, (3) seed tree, (4) shelterwood with final 30 trees per acre being removed in a single cut, (5) shelterwood with final 30 trees per acre being removed in four periodic cuts, and (6) shelterwood with final 40 trees per acre being removed in four periodic cuts. Table 9 shows cost and production figures for the initial conversion cuts under the six different methods.

Table 9.--Effect of method of cutting upon average log size, volume cut per acre, and logging cost f.o.b. truck

Treatment	Average log size	Volume cut per acre	Cost per M
	Board feet (Doyle rule)		Dollars
A	55.5	1,090	6.38
B	53.4	6,852	5.70
C	51.0	3,902	5.75
D	44.7	2,184	7.02
E	49.6	2,507	6.03
F	43.4	1,461	7.47

For the initial cut, the shelterwood systems (which leave most of the bigger and better trees as standards while removing all small trees) produced the smallest average logs with intermediate volumes cut per acre and the highest logging costs. The strip-cutting and seed-tree methods naturally result in larger average logs, the heaviest volumes cut per acre, and the cheapest logging costs. Selection cutting produced the largest average log, the lightest volume cut per acre, and intermediate logging costs. The most advantageous system cannot be decided, of course, until subsequent growth, costs, and adjustments for deferred returns have been determined.

A second installation has been completed of the test between D + 6 and a single-tree selection system of partial cutting in even-aged east Texas pine stands. There appears to be very little difference between the two systems in the first test--each left about 76 percent of the saw-timber volume.

Another study in east Texas showed that 45-year-old intermediate or suppressed pines would not grow faster than 20 rings per inch unless given practically complete freedom from competition.

A study of growth and mortality occurring with three different levels of growing stock was established near Urania, Louisiana, in 1915 in a 22-year-old stand of pine. Two of the levels were regulated by thinnings from below at 5-year intervals, while the third was an unregulated check. The heavier of the two thinning schedules periodically removed all but 60 to 100 square feet of basal area per acre, while the lighter thinning removed all but 85 to 105 square feet of basal area per acre. The uncut check has carried from 130 to 145 square feet per acre at all times. Periodic average annual cordwood growth over the 36-year period was best on the light thinning (1 cord per acre per year). At age 58 the mean annual increment of saw timber has been the same for all treatments (250 to 260 board feet, International 1/4-inch log rule) per acre per year, while the average d.b.h. of the 100 largest trees under each treatment is also about the same (12.2 to 12.5 inches)--an unexplainably slow rate of increase even under the heaviest thinning. Mortality has been negligible on all but the check plot, where it has averaged 0.4 cord per acre per year over the life of the study. Maximum growth of wood per acre per year would probably have been obtained by a light thinning taking only trees likely to die in the next 5 years. On the assumption of immediate liquidation and a 3 percent compound interest rate, the light thinning enjoyed a slight advantage over the heavy thinning and a considerable advantage over the check ($9.15 return per acre per year, as compared with $9.08 and $8.10).

Longleaf pine.--When the McNeill area in south Mississippi was logged in 1902-1903, about 10 small unmerchantable longleaf pines were left per acre. These formerly suppressed trees recovered remarkably. A study of 50 of them shows that they averaged 58 years old and 5.3 inches d.i.b. at stump height when released. Forty-seven years later, their stump d.i.b. was 15.3 inches, they averaged 63 feet high, and had a merchantable length of 45 feet. Their average volume per tree was 178 board feet (International 1/4-inch rule).

After release, rate of diameter growth at the stump increased for 25 years, reaching a maximum of 1.4 inches per 5 years, and then declined to 0.8 inch per 5 years. The smaller released trees grew more rapidly than the larger residuals. Diameter growth rate was greater in the trees with longer crowns. This study shows that completely released longleaf can recover from a long period of suppression and produce good quality sawlogs.

To put the stands in good growing condition, the first large-scale thinning and improvement cutting was made on 18 compartments of 38-year-old longleaf pine on the McNeill Experimental Forest during the year. Before thinning, stocking of pine 4 inches d.b.h. and larger averaged 135 trees per acre, equivalent to 18 cords. The partial cutting removed 30 trees per acre containing one-sixth of the merchantable volume per acre. Products from the average acre were 1,000 board feet of saw timber (International 1/4-inch log rule), 3 poles, 1/2 cord of pulpwood, and 10 fence posts. Cost of producing and transporting these products to the roadside was $13.77, while their roadside value was $28.26 per acre.

In 1934, 16 tenth-acre plots were established in 22-year-old longleaf pine stands at each of two locations in Baldwin County, Alabama. The stand in 1934 averaged about 2,300 trees per acre at the first location and about half that number at the second location. Three intensities of thinning were compared with unthinned checks. The plots were remeasured for the third time in 1949, 15 years after the first thinning.

Mortality reduced the stands on the unthinned check plots from an average of 2,270 to 880 trees per acre at the first location, and from 1,178 to 875 trees per acre at the second location. The mortality was mostly in trees below 4.5 inches d.b.h., but it indicates that the plots were overstocked. Only an occasional tree died on thinned plots.

These data indicate that basal area growth may increase rapidly as residual number of trees at age 22 increases, up to about 400 trees per acre. Little difference would be expected between 400 and 800 trees per acre, but above 800 trees per acre basal area growth probably drops off fairly rapidly. In a similar manner, cordwood volume growth may increase rapidly up to about 600 trees per acre, change little between 600 and 1,200 trees per acre, and fall off at a moderate rate above 1,200 trees per acre.

If the above hypotheses are correct, stocking for optimum per-acre growth in longleaf stands that are about 22 years of age might be about 600 to 800 trees per acre. Somewhat heavier stands might be left if they were rethinned in less than 15 years.

It now appears that the initial thinning of these plots could well have been delayed several years, at least in the lighter stands. A great many unmerchantable trees were cut in the actual thinnings at age 22, and there would be little or no profit from such an operation even today. By delaying a few years, a profitable cut could have been made and the same thinning objectives still realized.

Pruning in longleaf pine plantations

At Alexandria, Louisiana, polesaw pruning of longleaf pine plantations has been undertaken to determine cost and to find out the effect of such pruning on grade yields of lumber eventually to be obtained from these plantations. An average of 74 of the best quality trees per acre were pruned to 17 feet. Pruned trees averaged 5.0 inches d.b.h. Pruning time averaged 3.6 minutes per tree, or 16.7 trees per man-hour. At 80 cents per hour for labor, the cost was 4.8 cents per tree, or $3.55 per acre.

Net time per tree shows how tree size affects pruning time. It required 2.5 minutes to prune trees 4 inches in d.b.h., 2.8 minutes to prune 5-inch trees, 3.5 minutes to prune 6-inch trees, 4.0 minutes to prune 7-inch trees, and 5.2 minutes to prune 8-inch trees.

Bottomland hardwoods

Unmanaged bottomland hardwood stands usually contain a large volume of cull material that uses up growing space and interferes with the development of a new, more valuable stand. The need for timber stand improvement work in these hardwood stands is perhaps more necessary to successful forestry than is improvement cutting in managed pine stands.

In 1939, an area of typical run-down hardwood stand at the Delta Experiment Station in Mississippi was given two intensities of improvement cutting to put the stand into better growing condition. Uncut areas served as a check on the results of the treatments. Table 10 compares original stands and treatments.

Table 10.--Volumes and basal areas per acre involved in tests of bottomland hardwood improvement cutting

Improvement cutting	Original stand		Trees removed			
	Volume 1/ per acre	Basal area 2/ per acre	Volume 1/ per acre		Basal area 2/ per acre	
	Bd. ft.	Sq. ft.	Bd.ft.	Pct.	Sq.ft.	Pct.
Heavy	1,278	57.5	962	75	39.2	68
Very heavy	1,788	63.3	1,451	81	51.1	81
Uncut	1,815	63.3	0	0	0	0

1/ Trees over 13.5 inches d.b.h., International 1/4-inch log rule.
2/ Trees over 5.5 inches d.b.h.

Since 1939 the uncut stand made the greatest total board-foot growth, but the stand which was heavily cut showed the greatest growth relative to the residual stand. Both of the stands which were cut are still accelerating their growth per acre, as can be seen from table 11.

Table 11.--Residual stands and subsequent growths per acre for three intensities of bottomland hardwood improvement cutting

Improvement cutting	1939 residual stand		1939-44 5-yr. growth		1944-49 5-yr. growth	
	Volume 1/ per acre	Basal area 2/ per acre	Volume 1/ per acre	Basal area 2/ per acre	Volume 1/ per acre	Basal area 2/ per acre
	Bd. ft.	Sq. ft.	Bd. ft.	Sq. ft.	Bd. ft.	Sq. ft.
Heavy	316	18.3	415	14.3	1,093	15.7
Very heavy	337	12.2	374	11.9	921	14.1
Uncut	1,815	63.3	1,192	15.3	1,334	7.8

1/ Trees over 13.5 inches d.b.h., International 1/4-inch log rule.
2/ Trees over 5.5 inches d.b.h.

Despite the greater board-foot growth on the uncut stand, 67 percent of its 1949 saw timber was of poor quality, as compared with 7 percent in the heavily cut stand and 4 percent in the very heavily cut stand. Thus, more high-quality timber has been produced on treated stands than on untreated stands.

Study of three methods of managing east Texas bottomland hardwood stands has been initiated on the Stephen F. Austin Experimental Forest. In treatment A, all trees currently merchantable have been cut. In treatments B and C, only merchantable trees which have ceased to be good investments have been cut. Non-merchantable trees which are undesirable growing stock remain alive in A and B but have been deadened in C.

Treatment A left 2,700 board feet per acre (International 1/4-inch log rule) in trees containing logs larger than 9.5 inches d.i.b., of which 53 percent were undesirable as growing stock. Treatment B left 4,900 board feet per acre, of which only 29 percent were undesirable; and Treatment C left 3,700 board feet per acre, all desirable for growing stock. It is expected that treatment C will grow the most high-quality material, but it is not known whether it will so far surpass treatment B as to compensate for the expense of deadening.

Existing knowledge on how to manage bottomland hardwood has been compiled at the Delta Branch Station and will be made available soon in published form.

Redcedar

A study of effect of several different management practices upon the growth and yield of eastern redcedar in the Sylamore district of north Arkansas was undertaken in 1947. Remeasurement of the study areas shows (table 12) that redcedar responds well to improvement cutting and the removal of overstory cull hardwoods. Increment borings made in sample trees indicated that growth response began the second year after treatment. Best response in growth percent resulted from a combination of improvement cutting of the cedar plus removal of cull overstory hardwoods.

Table 12.--Growth of redcedar stands

Cutting treatment		Redcedar volume per acre			Periodic annual growth rate (compound)
Redcedar	Overstory hardwoods	April 1948	Oct. 1950	Periodic annual growth	
		Cubic feet, inside bark			Percent
Not cut	Not cut	1,015.8	1,093.1	25.8	2.4
Not cut	All cut	1,362.6	1,527.4	54.9	3.9
Improvement cut	Not cut	447.8	501.6	17.9	3.9
Improvement cut	All cut	312.6	404.6	30.7	9.0

Natural regeneration

Longleaf pine.--Records of cone production on eight second-growth longleaf seed trees in south Mississippi have been made annually since 1946. The trees now average about 12 inches in d.b.h. On a dry, sandy site four seed trees produced an average of more than a bushel of cones per tree (100 or more cones per tree) in 2 of the last 5 years. Four trees on slightly better soil fertilized by chicken manure each averaged a bushel or more of cones in 4 of the 5 years. This indicates that even on poor sites good second-growth longleaf seed trees can be made to produce 2 to 10 thousand seeds per tree in 4 out of 5 years.

It has been found, in addition, that large longleaf cones produce more and heavier seed than smaller cones from the same trees. Thus, other things being equal, the greater number of seeds per cone makes longleaf with large cones better seed trees than those with smaller cones. There appear to be about 100 seeds (each seed weighing 85 milligrams) in a 6½-inch cone, but the number of seeds per cone and the weight per seed will increase or decrease with cone length, at a rate of about 28 seeds per cone and 16 milligrams per seed for each inch difference in length. These estimates presume an ample pollen supply.

In south Mississippi during the last 2 years, longleaf seedling growth on small plots where pine logs have been burned has been double that where 14- or 15-year grass rough was burned just before seedfall, even though wood ashes were added to the plots where grass was burned. This last point indicates that the growth stimulation caused by burning logs is attributable to the fact that the burning kills grass roots and not to any fertilizing or mulching effect of the residual wood ash. The diameter at the ground line of yearling seedlings averaged 0.17 inch where only grass had been burned, and 0.35 inch where logs had been burned. In the second year, it was found that yearling seedlings increased about 0.06 inch in diameter from mid-November to late March 1950, when grass competition was not severe. Seedlings where logs had been burned grew more in one year than seedlings where grass had been burned did in 2 years, despite the fact that the almost complete absence of grass protection where logs had been burned caused more than half the seedlings to become infected with brownspot.

A small test indicates that allyl alcohol applied at a rate of 50 gallons in 10,800 gallons of water per acre to the rough before seeding in November will reduce grass competition enough to stimulate seedling development significantly. Where grass alone was burned, 1-year-old seedlings averaged 0.13 inch in diameter; where allyl alcohol was applied following grass burning, diameters averaged 0.20 inch; and where logs were burned, diameters averaged 0.39 inch. All these seedlings were sprayed with Fermate or Bordeaux mixture to control brownspot. Some plots were broadcast-fertilized in November 1949 with 2,700 pounds of 5-15-5 mineral fertilizer per acre. Fertilization reduced seedling growth slightly on plots where the grass had been burned or where allyl alcohol had been applied, but greatly stimulated grass growth and flowering of bluestem. On plots where logs had been burned, fertilization increased seedling growth a little.

Shortleaf-loblolly pine.--In central Alabama, loblolly pine reproduction has shown much more ability to live under an overstory than has shortleaf. In the fall of 1947, 60 loblolly and 60 shortleaf seedlings were tagged and measured. One-half of each group was released by an intensive improvement cutting that removed all undesirable stems down to a diameter limit of 1.6 inches. Of the 30 nonreleased loblollies, 22 (or 73 percent) are still living, but only 7 of the shortleaf are still alive (23 percent).

In south Arkansas, pine reproduction that becomes established beneath a dense hardwood canopy eventually dies from the intense competition. Whether mortality is caused by competition for light or for soil moisture and nutrients is not known. To help decide on the amount and character of hardwood that should be removed when releasing suppressed pine reproduction, a study was installed in the spring of 1949. Small plots, each having a 1-year-old loblolly pine seedling surrounded and overtopped by hardwoods about 1 to 3 inches d.b.h., were treated by factorial combinations of trenching, watering, and tying hardwoods back so as to allow full sunlight to reach the seedlings.

First-year height growth indicates that competition for soil moisture and nutrients is more critical than competition for light. Where the seedlings were freed from root competition with the hardwoods by trenching, height growth was increased significantly. Where the plots were trenched and the hardwoods were tied back to permit sunlight to reach the seedling, pine growth was no better than on the plots with trenching alone. Watering the plots when soil moisture dropped to 12 percent also increased height growth.

Mensuration

Representatives of the Southern and Southeastern Forest Experiment Stations and Region 8 of the U. S. Forest Service made their final report on southern pine log and tree grades after 3 years of study. They jointly recommended pine log and tree grades, together with a technique for testing future proposals for grade improvement. The factors considered in the joint log grades were number, size, and character of knots, number of clear faces, amount of sweep, and log d.i.b.

An article on point-sampling (sometimes called variable plot radius cruising) was submitted to the Journal of Forestry. The technique promises to facilitate extensive reconnaissance and analysis of stand structure and stocking. It allows determination of the tree sample by angle-gauging, so that basal area per acre or volume per acre may be estimated without measuring tree d.b.h. or plot radius.

Measurements of radial growth and volume of 1,800 sample eastern redcedar trees on 91 plots in north Arkansas were worked up for a proposed bulletin on redcedar distribution and growth.

Fire

Shortleaf-loblolly pine

In east Texas, 400 acres of the shortleaf-loblolly pine-hardwood type were prescribe-burned for seedbed preparation and hardwood control. Eleven separate burns were made at various times of the year in order to secure information on burning conditions necessary for optimum results. Headfires were used after it was found that flank and backfires did not give satisfactory burns in this forest type. A comparison of three 1950 burns shows (table 13) that burning on a day with a class 4 fire danger rating gives a much better kill of understory hardwoods than burning on days with a class 2 or 3 fire danger rating, using the danger rating system employed by the Southeastern Forest Experiment Station. Danger is rated from 1 to 5, depending for the most part on how fast a fire will spread.

Table 13.--Effect of fire danger rating upon reduction of hardwood by controlled burning

Date of burn	Fire danger rating	Reduction in number of hardwood stems 0.5 to 2.5 inches in diameter	Reduction in height of understory hardwood canopy
		- - - - - - Percent	- - - - - -
February 24	2	55	27
February 17	3	67	49
March 19	4	90	57

Summer fires have been found to be more destructive to both pine and hardwood than fires at other times of the year. Temperature rise due to fire plus high air temperatures at this season result in extreme temperatures which kill trees much more readily than at other seasons. From a management standpoint, summer fires may be useful where hardwood stands containing no pine are to be converted to pine; in preparation of sites for seeding or planting; and in management systems where alternate or progressive strips or patches are clear-cut, leaving an adjacent seed source for regeneration. Summer fires are not yet recommended where seed trees or other overstory pines or saplings are present.

The larger the area burned, the smaller the cost per acre. In general, 40-acre blocks can be burned for approximately 25 cents per acre. If natural firebreaks (such as woods roads) are available, or if larger areas are burned, these costs are decreased. Small areas and plowed fire lines increase unit costs.

Longleaf pine

In November 1947, longleaf seedlings in south Mississippi were germinated on fresh burns and on older roughs. In March 1949 (16½ months later), the fresh burns were reburned, and 73 percent of the seedlings survived, as opposed to only 31 percent on the reburned older roughs. When the burns were repeated 27½ months after germination (February 1951), seedlings which had germinated on fresh burns had 76 percent survival, as compared with 38 percent for seedlings which had germinated on an older rough. Burning immediately before seedfall appears to lessen greatly the loss from subsequent fires.

Rehabilitation of Forest Soils

A study in northern Mississippi found indications that the litter under loblolly pine may weigh 6 tons per acre more than the litter under eastern redcedar. However, the proportion of calcium (by weight) was 3 percent higher in the redcedar litter, and there was also more excess base in the redcedar litter. The surface 2 inches of soil showed significant advantages--possibly attributable to the redcedar--in such characteristics as organic matter, alkalinity, exchangeable base, depth of new A_1 horizon, water transmission rate, total pore space, and moisture at sampling time. Only in volume per unit weight was there a possible advantage attributable to loblolly. Herbaceous cover tended to be inferior to either redcedar or loblolly in soil-building characteristics. All in all, where redcedar will survive, it appears to be the best soil builder of the three.

A reconnaissance correlating forest type and geology in a small area in the north Arkansas Ozarks indicated that hardwoods predominate on northerly slopes derived from sandstone, while southerly slopes derived from sandstone tend to be covered with pine. Hardwoods predominate on all cherty limestone slopes, although an appreciable pine component is found on southerly exposures. Redcedar is primarily limited to slopes derived from pure limestone, with an appreciable hardwood component creeping in on northerly exposures. The existence of such associations allows cover type to be predicted from a topographic-geologic map.

An empirical investigation of soil-site relationships on the Bankhead National Forest in Alabama has led to a scheme of site evaluation in which loblolly site index is estimated at 77 + Topographic score + Aspect score + Gradient-Soil score. Topographic score is 0 for flats or broad ridge tops, plus 4 for bottoms or lower slopes, minus 2 for upper or middle slopes and narrow ridgetops. Aspect score is 0 for exposure within 22½ degrees of due east or west, plus 8 for more northerly aspects, and minus 3 for more southerly aspects. Gradient-Soil score is read from table 14, which follows.

Table 14.--Gradient-soil score in empirical site evaluation scheme for Bankhead National Forest

Soil group[1]	Gradient less than 8 percent	Gradient 8-20 percent	Gradient more than 20 percent
	- - - - -	Score in percent	- - - - - -
A	+9	+7	-2
B	+2	0	-2
C	-5	-11	-12
D	-12	-13	-17

[1] A--fine sandy loam, silt loam, chocolate-brown fine sandy clay, red or red-brown very fine sandy clay.

B--moderately deep heavy clays; moderately deep, pronouncedly mottled, sandy loam; moderately deep hardpan, moderate clay; slightly mottled, red or red-brown fine sandy clay; yellow-brown very fine sandy clay.

C--yellow-brown fine sandy clay.

D--sandy soils or clays shallower than 3 inches with hard or badly eroded surface.

Farm Forestry Research

Alabama

Work on the Alabama farm forestry pilot plant study was continued during the year. The original preliminary report was rewritten on the basis of additional data and approved during the year. The effects of chemical farm fertilizers upon fusiform rust of pine were studied in Autauga County, and two articles were prepared for publication. A revised woodland management plan was prepared for the dairy-cotton farm unit at the Piedmont Substation at Camp Hill, Alabama.

Mississippi

Two hundred acres of the Newton County farm forest management unit were given an intensive improvement cutting during the year. The cutting yielded a net return of $15.02 per acre.

A working plan has been prepared to study production, costs, and returns from growing Christmas trees in north-central Mississippi.

FOREST ECONOMICS

Forest Resources

Mississippi's forest resources and industries

A comprehensive report on the forest situation in Mississippi was submitted for publication by the Department of Agriculture. This report is primarily the product of the new Forest Survey of the State, made between 1946 and 1948; but it also draws on the first Forest Survey, carried out in 1932-1935.

Timber-products industries rank just behind farming as one of the two major parts of Mississippi's economy. Nearly one dollar out of every four dollars of income received from private enterprise by the 2,100,000 people in the State comes directly from timber products. Direct employment in the harvesting and manufacture of timber products totals some 68,000 man-years annually.

Forest acreage increased 2 percent during the 14 years between the two Forest Surveys, but timber volume, quality, and size have declined in most respects. Board-foot volume dropped a fourth. Nearly two-thirds of the sawlog timber is of grade 3 quality. One out of every four trees in the forest is a cull. Pine forests have been converted to hardwood on 2.2 million acres. Numbers of softwood trees under 8 inches d.b.h. increased; in all larger sizes, the numbers decreased. Hardwoods increased up through 14 inches d.b.h., but declined in all larger sizes.

Use of the forest continues heavy. Despite declines in some products, the total output has been sustained for about three decades. This has been done mainly by overcutting the forest; by using smaller trees, poorer quality trees, and less desired species; and by expanding the output of less exacting products, particularly pulpwood. More than a fourth of the cut of sawlog-size timber in the past 14 years has been made at the expense of forest growing-stock volume.

Management on the 90 percent of the forest in private ownership is generally poor, although most of the large industrial holdings and some of the smaller properties are under good management. Little more than a fourth of the forest held by Mississippi's 145,000 private forest landowners is given fair or better management. Owners of close to half the private forest do not understand what timber management involves; most of them do not recognize that their timber management could be improved.

The present outlook is for large contractions in some of Mississippi's important wood-using industries unless timber management improves rapidly. The prospect is that softwood lumber, standard hardwood lumber, veneer logs, and tight cooperage will be hit hardest, but softwood pulpwood and other products may also be forced into decline.

The situation calls for drastic improvements in timber management. Better timber management can eventually create a productive resource and a prosperous forest economy. A growth goal of 800 million cubic feet of all timber, including 3 billion board feet of saw timber, would meet Mississippi's need and enable the State to contribute its share toward meeting national timber requirements. The goal calls for a 50 percent increase in cubic volume of standing timber, a 65 percent increase in board-foot volume.

Tree distribution in Mississippi

Forest Survey Release 64 was issued as part of the Survey series of publications on Mississippi's forest resources. This report describes, in the form of maps, the geographic distribution of 17 selected tree species and groups of species within the State. Only species of commercial value are considered, and only trees of merchantable form. Because these maps indicate the relative concentrations as well as the approximate range of such trees, they should be of value both to the forester planning timber management and the wood user seeking raw material.

Timber resources in Tennessee

The Station completed its inventory of the forest resources of Tennessee at the end of the year. Computations are in progress for a report on forest acreage and timber volume in eastern Tennessee and for a State-wide report covering all Forest Survey findings.

Timber resources in Arkansas

The Station is currently completing its Forest Survey of Arkansas. The field inventory in the Ozarks region was finished in 1948, and findings were published in Forest Survey Release 57. Survey Release 65, published in 1950, described the timber resources of southwest Arkansas. Field work for the Delta regions has just been completed and computations of data are under way. The Ouachita Mountains region will be surveyed early in 1951.

Following are a few highlights of the Survey findings in the 20 counties of southwest Arkansas.

Southwest Arkansas is predominantly a forest region. Seventy-one percent of its 8.9 million acres is commercial forest land; a major part of its economic activity is the extraction and processing of timber products.

In the 13 years between the two Forest Surveys of the region (1936 and 1949), forest-land acreage increased 6 percent, mainly because of farm-land abandonment. While the forests were spreading, they were also changing in species composition and timber volume. In general, softwood (mainly pine) decreased in extent and quantity, while hardwood increased. Heavy cutting of pine and vigorous growth of hardwood were among the causes. Important is the fact that owners of perhaps a third of the forest are managing their land so as to build up timber stocking, especially of pine; but that on the remaining bulk of the forest, poor management and timber deterioration are still the rule. Here are some of the net effects of these conditions:

Between the two Surveys, the acreage classed as pine forest decreased 9 percent to 1.9 million acres; pine-hardwood increased 20 percent to 2.0 million acres; upland hardwood forests increased 35 percent to 1.1 million acres.

In total growing stock, the 2.6 billion cubic feet of softwood represents an 8 percent drop since 1936. Hardwood, totaling 2.0 billion cubic feet, is up 4 percent by virtue of heavy increases in small trees.

In sawlog growing stock, both softwood and hardwood declined 2 percent between the two Forest Surveys. The 1949 saw-timber volumes are 11.3 and 6.9 billion board feet, respectively.

Looking toward a comprehensive Forest Survey report on the forests and forest industries of Arkansas, a study of current logging operations in the State was made.

From a representative sample of logging operations, data were collected on the size and quality of trees cut and the proportion of stands removed for each of the major timber products. In general, the stands selected for cutting contain larger trees than are found in the average timber stand. The size and quality distribution of trees cut was found to be similar to that of stands before cutting, except that logging tends to be concentrated in the larger and better grade trees. Hardwood stands are cut less heavily than pine stands, and the residual timber is generally of low quality.

Forest Industry

Forest industries and timber drain in Arkansas

Sawlogs, pulpwood, and fuel wood in 1948 accounted for almost nine-tenths of the total volume of timber products cut in Arkansas, according to the State-wide canvass of Arkansas forest industries and other timber users made by the Forest Survey. The total cubic volume of all timber products cut in that year is estimated at 450 million cubic feet--232 million feet in softwoods, 218 million in hardwoods.

In softwoods, sawlogs and pulpwood alone accounted for 91 percent of the volume. In hardwoods, sawlogs and fuel wood accounted for 81 percent; and veneer, cooperage, handle-stock, and other specialties accounted for an additional 10 percent (table 15).

There are in Arkansas just over 2,000 sawmills, but 98 large and medium-size mills located principally in the southwest part of the State saw over one-half of the lumber. Other primary wood-using plants include two pulp mills, 51 plants manufacturing handles or handle-stock, 33 manufacturing cooperage stock, 18 manufacturing veneer, and 24 turning out other products. Furthermore, 5 wood-preserving plants serve as concentration points for railroad ties, poles, piling, and posts.

Table 15.--Distribution of volume of output by product and species group, 1948

Product	Total	Softwood	Hardwood
		Percent	
Sawlogs	57	73	39
Fuel wood	22	4	42
Pulpwood	10	18	2
Logs and bolts for veneer, cooperage, handle-stock, and other specialties	5	1	10
All other	6	4	7
Total	100	100	100

Forest industries and timber drain in Tennessee

As part of the Forest Survey of Tennessee, a State-wide canvass of forest industries and other timber users was made to determine the 1949 output of timber products. The data are now being compiled.

Pulpwood production in 1949

Pulpwood production in the Station's territory totalled 4,387,000 cords in 1949, a 13 percent decrease from 1948. Pine accounted for 91 percent of the 1949 production, or 4,002,600 cords; hardwood for 9 percent, or 384,400 cords (table 16).

Table 16.--Pulpwood production in Southern Station territory, 1949

State	Total	Softwood	Hardwood	Percent change from 1948
	- - - Thousand cords		- - - -	Percent
Alabama	911	893	18	-7
Arkansas	561	508	53	-9
Louisiana	760	726	34	-20
Mississippi	1,168	1,028	140	-19
Oklahoma	38	38	Negl.	+10
Tennessee	158	60	98	-13
Texas	791	750	41	-4
All States	4,387	4,003	384	-13

New mills drawing wood from the territory went into operation during 1949 and 1950 at Childersburg, Alabama; Natchez, Mississippi; and Shreveport, Louisiana.

Logging methods, equipment, and costs of round mine prop production

A study was made to determine the costs of producing coal mine props in the Birmingham district and to compare various felling and bucking tools. Tentatively, the results showed that although felling costs per tree and bucking costs per cut were only 5 percent greater for upland oak and hickory than for pine and yellow-poplar, total direct costs per prop were about 25 percent higher for the upland hardwoods than for the pine and poplar. The greater cost resulted primarily from the additional felling and skidding required to obtain a given number of props from the short-boled hardwoods.

A three-man crew using a power chain saw with a 24-inch bar for felling and a bow attachment for bucking was found to be faster and cheaper for producing 4- to 8-foot mine props than a two-man crew using a Swedish bow saw or a two-man crew using a conventional cross-cut saw. However, delays with the power saw are expensive and the advantage might easily be wiped out by poor engine performance or an inefficient crew. When 3-foot props were cut from 5- and 6-inch d.b.h. trees, the two-man bow-saw crew was the most economical.

The cross-cut saw crew was about 15 percent faster than the bow-saw crew for felling trees 11 inches d.b.h., but for trees from 5 to 9 inches there was little difference between the two. The power chain saw crew felled 9-inch trees in about one-half the time required by the cross-cut saw crew.

When stems larger than 9.5 inches were bucked, the cross-cut saw was found to be superior to the bow saw; for bucking diameters from 4.0 to 9.5 inches, the bow saw was about 10 percent faster and cheaper than the cross-cut. The power saw with bow attachment bucked 9-inch d.b.h. trees about 30 percent faster than did the bow saw.

Utilization of inferior upland hardwood

Military requirements for low-quality hardwoods for such items as dunnage, pallets, crating, and boxes may be expected to expand. Costs of deadening large volumes of upland hardwoods in the management of pine may be reduced and waste of needed material avoided by more complete utilization of all hardwoods that will yield a net profit, no matter how small. There is urgent need for classification of these low-grade trees into value classes that can be used in a given demand-price situation, to distinguish between trees that should be utilized and trees that should be deadened.

A project at the East Texas Branch in cooperation with the Texas Forest Service is supplying this information. During 1950, 530 low-grade logs were sawed and their 4/4 standard lumber-grade recovery determined.

Although only a negligible amount of FAS and selects was obtained from these logs, 37.6 percent of the recovery was of No. 2 common or better grade. Except in gum, there was a higher average yield of No. 2 and better lumber from factory lumber logs than from logs of other classes, and a higher average yield from logs above 11 inches in diameter than from smaller logs. Grade yield of sweetgum was higher than that of oaks; this advantage was increased by the sound cutting grade, No. 2A, for which oak is not acceptable. Post oak gave the poorest average grade yield, with red oak intermediate.

Economics of Forest Management

Guides to profitable forest management

Financial maturity of pine.--On the Texas National Forests, after one or more improvement cuttings, the stands contain large, high-grade shortleaf and loblolly pines, some of which may be financially mature. A study was made to determine the point of financial maturity and to offer marking rules for selecting mature trees.

The rate at which a tree increases in value is the measure used to determine when the tree is mature. Value increase depends on the rate of volume growth and of quality improvement. Although the value increases as a tree grows larger, the rate of increase decreases. Eventually, the rate of tree-value increase falls below that which can be obtained from alternative investments of similar risk and the tree ceases to be an advantageous investment.

While the alternative rate of earning for a private forest property would be higher, for the Government a rate of 2 percent seems suitable. The problem on the National Forests then was to determine at what point the rate of value increase of shortleaf and loblolly pines falls below 2 percent. Trees of different diameters and heights were studied, and the rates shown in table 17 determined.

Table 17.--Rates of value increase, in percent, for shortleaf and loblolly pines, Texas National Forests

Diameter breast high (inches)	Annual compound rate of value increase when the 10-year diameter growth is--					
	3 inches	2.5 inches	2 inches	3 inches	2.5 inches	2 inches
	- - - 4-log trees - - -			- - - 3-log trees - - -		
14	8.1	6.9	5.6	7.8	7.0	5.6
16	6.7	5.8	4.7	6.5	5.6	4.5
18	5.5	4.7	3.8	5.4	4.6	3.9
20	4.3	3.7	3.1	4.2	3.6	2.9
22	3.4	2.9	2.4	3.3	2.8	2.4
24	2.9	2.5	2.0	2.7	2.3	1.8
26	2.4	2.0	1.6	2.3	2.0	1.6
28	2.2	1.8	1.4	1.8	1.5	1.3
30	1.8	1.5	1.3	...	...	...

It appears from the study that the largest size of loblolly pine (averaging four logs) to be left one more 10-year cutting cycle is 29 inches d.b.h. for trees growing 3 inches, and 24 inches for trees growing 2 inches during this period. In shortleaf pine (averaging 3 logs), the largest size tree to be left one more cutting cycle is 26 inches for trees growing 2½ inches, and 23 inches for trees growing 2 inches. For estimating growth rate, tree vigor classes have been defined, the classes being based on bark and crown characteristics.

Financial maturity of bottomland hardwoods.--Bottomland hardwoods of good form, when grown to large size, yield high-grade standard factory lumber. Like pine, however, these trees eventually reach a point when the investment in them had better be liquidated and put to some more productive use.

A study was made of bottomland red oaks and sweetgum in the territory of the Delta Branch in order to furnish guides that forest owners may use to decide when to harvest their trees. Values were calculated for red oaks and sweetgums of various sizes and grades, and future values after 10 years and rates of value increase were estimated for trees of three vigor classes. Ten-year diameter growth in inches for three vigor classes of red oaks and sweetgum follows:

Vigor class	Red oaks (Inches)	Sweetgum (Inches)
1	4	3½
2	3	2½
3	2	1½

Table 18 shows, for 2-log red oak and sweetgum trees with a grade 1 butt log and a grade 3 second log, the rate of increase in value over a 10-year cutting cycle.

Table 18.--Annual compound rate of value increase, in percent

Diameter breast high (inches)	Red oak; vigor class			Sweetgum; vigor class		
	1	2	3	1	2	3
18	12.5	9.1	7.3	9.9	7.3	4.6
20	8.3	6.4	4.8	7.0	5.0	3.1
22	6.9	5.3	3.7	5.7	4.0	2.3
24	5.9	4.6	3.1	4.9	3.5	2.1
26	5.1	3.9	2.7	4.4	3.1	2.0
28	4.6	3.4	2.4	3.8	2.7	1.6
30	3.8	2.9	2.3	3.4	2.4	1.4

Where his alternative rate of return is 4 percent, a forest owner would derive the following marking rules, cutting trees when they have passed these diameters:

Vigor class	Red oaks (Inches d.b.h.)	Sweetgum (Inches d.b.h.)
1	28	26
2	24	22
3	20	18

Optimum stocking of selection forests.--A report was prepared on a study of optimum stocking of all-aged pine forests. The purpose of the study was to furnish a guide which forest owners may use in determining optimum stocking--i.e., the optimum point at which to stop building up the growing stock.

The report shows that this point is reached when the special cost of holding any extra growing stock (the alternative rate of return) is just equal to the revenue from the extra growing stock (the "marginal growth").

This principle is applied to theoretical stands of shortleaf and loblolly pine on good sites with assumed proper distribution of size classes. It is found that under a 5-year cutting cycle and with a 4 percent rate of return from alternative investments, a stand of 9,000 board feet (International 1/4-inch rule) at the beginning of the cycle is optimum. At the end of the 5-year cutting cycle, the stand would be cut back to 9,000 board feet. During the 5-year period, the saw-timber portion of the stand is estimated to increase as follows:

	Beginning	End
Number of trees 10+ inches d.b.h.	42.2	51.6
Basal area, square feet	52.3	68.9
Volume, board feet (International 1/4-inch rule)	9,000	12,380

Returns from well-managed commercial forests

Loblolly-shortleaf-hardwoods.--A 10-year progress report was completed, covering all operations for the years 1938-1947 in the 1,000 acres of selectively managed loblolly-shortleaf pine-hardwood stands on the Crossett Experimental Forest. The total 10-year returns per acre from stumpage sold were:

Pine sawlogs	$18.31
Hardwood sawlogs	7.70
Pine and gum pulpwood	5.96
Hardwood chemical wood	.51
Total	$32.48
	or $3.25 per acre per year

The annual costs of intensive commercial management averaged as follows:

Item	Cost per acre per year
Fire protection	$0.040
Cruise and management plan	.025
Timber stand improvement	.037
Timber marking (240 acres per year)	.060
General supervision	.190
Car expense	.016
Car depreciation	.023
Road maintenance	.110
Road depreciation	.106
Taxes	.120
Total	$0.727

When the above costs are deducted, the net returns per acre are $25.21, or $2.52 per year. Stumpage prices, however, were very low during some years. If 1949 prices are applied to the products harvested, the net return per acre becomes $51.44 for the 10-year period, or $5.14 per year.

During the 10-year period, hardwoods, because of their slow growth and low quality, were cut heavily to favor the faster growing, more valuable pines. This decreased hardwood growing stock approximately 600 board feet per acre and increased pine growing stock about 1,800 board feet. While the pine saw timber was being increased in volume during the 10 years, pine pulpwood growing stock decreased about a cord per acre.

In terms of 1949 prices, these changes in growing stock have resulted in a net increase in growing stock of more than $20 per acre during the 10 years, or about $2.00 per acre per year.

Longleaf.--At the Brewton Branch, the second year's cut in the intensively managed section of longleaf pine covered 76 acres and removed 36,700 board feet (Doyle rule) of sawlogs, 205 poles, and 146 cords of pulpwood. The delivered value of the products was $3,350. A total of 2,181 man-hours of labor costing $1,289, truck operation costs of $309, and other costs of $228 made a total cost of $1,826, leaving $1,524 for operator's profit and risk and for stumpage.

Table 19 shows costs and returns per unit for various products:

Table 19.--Costs and returns per unit from sawlogs, poles, and pulpwood

Item	Sawlogs, per M bd. ft. Doyle scale	Poles, per pole	Pulpwood, per cord
	Dollars		
Delivered value	33.35	3.42	9.75
Production costs	18.23	1.51	5.80
Margin for profit, risk, and stumpage	15.12	1.91	3.95

Considering all returns and all costs, including costs of timber growing, the net receipts to the owner-operator and his land amounted to $1.94 per acre per year over the 2-year life of the study. Additional growth above cutting is worth about 50 cents per acre per year as accrual to the investment.

Returns from well-managed small tracts

Studies of costs and returns from small intensively managed forest tracts were continued during 1950 on the experimental forests at six branch stations, and initiated at two other branches. The purpose is to determine and demonstrate the financial possibilities of managing and annually harvesting timber on small tracts. The chief product grown and harvested at all branch stations is sawlogs, with pulpwood, fence posts, and fuel wood as byproducts. In the longleaf pine territory, naval stores are also being produced.

The period during which these studies have been under way varies up to 13 years. Records of experience and of costs and returns in the several timber types of the lower South are yearly becoming more complete and more valuable. The advantages of good stocking and of intensive management are being shown. Significant results are recorded below.

In order to study returns from upland pine-hardwood stands, improvement cuts have been made annually for 3 years on a poorly stocked and a medium-stocked tract at the Birmingham Branch. The poorly stocked compartment of 36 acres supports 32 square feet of total basal area and 1,500 board feet (International 1/4-inch rule) of saw timber per acre. During 1950, the total cut from the compartment was 1,535 board feet of sawlogs and 301 mine props (mostly oak and hickory), which brought a delivered price of $77.43, or $2.15 per acre. A total of 2.4 man-hours per acre was required to cut and deliver the products. When out-of-pocket costs of 25 cents per acre were deducted, the gross man-hour return (for stumpage and labor) was 80 cents. If a stumpage value of 35 cents per acre is deducted, the net man-hour return (for labor alone) is 65 cents.

The moderately well-stocked unit contains 38 acres, with an average of 78 square feet of basal area and 3,500 board feet of sawlog volume per acre. Improvement cuts in 1950 removed a total of 3,040 board feet of sawlogs and 677 mine props (mostly Virginia and longleaf pine), which brought a delivered price of $281.73, or $7.41 per acre. A total of 6.0 man-hours per acre was required for logging and hauling the products. When out-of-pocket costs of 72 cents per acre were deducted, the gross man-hour return was $1.11. The net man-hour return, excluding stumpage of $1.02 per acre, was 94 cents.

At the Brewton Branch in south Alabama, intensive forestry has been practiced in second-growth longleaf pine on a relatively "good" and a "poor" forty-acre tract. The good forty supports 39 square feet of basal area, 1,625 board feet (Doyle) of sawlog volume; the poor forty, 19 square feet and 1,024 board feet. Longleaf pines to be removed were turpentined for 2 years before cutting. Table 20 shows the harvesting returns from 2 years' operation on the two forties.

Table 20.--Returns from 2 years' operations on forty-acre forests near Brewton, Alabama, 1948-1949

Product	Volume harvested	Delivered value	Labor for logging and delivery	Gross return per man-hour[1]
		Dollars	Man-hours	Dollars
	GOOD TRACT (40 ACRES)			
Crude gum	15.41 std. barrels	333.04	322	0.92
Sawlogs	9,919 bd. ft. Doyle	328.77	143	1.71
Pulpwood	14.05 std. cords	136.99	106	.61
Fuel wood	16.8 std. cords	134.40	227	.45
Posts	205 pieces	34.24	45	.70
All products		967.44	843	.88
Average per acre per year		12.09	10.5	...
	POOR TRACT (41 ACRES)			
Crude gum	9.60 std. barrels	208.38	288	0.61
Fuel wood	9.0 std. cords	72.00	152	.38
Posts	205 pieces	33.18	68	.45
All products		313.56	508	.51
Average per acre per year		3.82	6.2	...

[1] Return for stumpage and labor (delivered value minus cash costs).

The only management costs included in the table are for Ammate that was applied to stumps of oak trees cut for fuel wood. Other management costs for the 2 years are as follows:

	Good 40	Poor 40
Cash outlay	- - Dollars	- -
Taxes	5.80	3.48
Prescribed burn (tractor and plow)	...	2.11
Timber marking (paint)	1.50	.50
Total	7.30	6.09
Average per acre per year	.09	.08
Labor outlay	- - Man-hours	- -
Marking timber	6	4
Prescribed burn	...	6
Total	6	10

At the Crossett Branch in southern Arkansas, 13 annual cuts averaging 12,400 board feet of logs, 23 cords of pulpwood, 18 cords of fuel wood, and 32 fence posts per year have been made on the "good" forty composed of loblolly-shortleaf pine and hardwoods. Annual stumpage returns have averaged $219, and mill or market values $649 per year over the period. These returns have been equivalent to an annual per-acre return of $5.48 for stumpage, or of $16.23 for products delivered to market.

Over the 13-year period, a total of 4,020 board feet of logs, 7.35 cords of pulpwood, 5.71 cords of fuel wood, and 10.45 fence posts have been cut from the average acre. The amount of logs cut is equal to 64 percent of the log volume present when the study was started. Total volume of all products cut has been equal to approximately 21 cords per acre, 82 percent of the volume present when the study started. The stand today contains approximately the same volume as it did 13 years ago, and the volume is in trees of better average quality than were present when the study started.

To put the stand into good growing condition and to pay expenses, annual cuts of salable products have also been made from a "poor" forty. In order to build up the growing stock on this area, the annual cuts have been equal to only about half of the growth produced by the woodland.

The average annual cut has been equal to 407 board feet of logs, 12.35 cords of pulpwood, 13.20 cords of fuel wood, and 10 fence posts per year. Annual stumpage returns have averaged $109, and market value has averaged $325 per year for the tract (34 acres). These values have been equivalent to an annual per acre return of $3.22 for stumpage and $9.55 for delivered products.

Even though the volume of sawlogs and of other products cut in 12 years is nearly as large as the volume of original growing stock, the volume now on the area is considerably greater than was present originally.

The third annual cut was made at the East Texas Branch on the farm forestry unit of 67 acres of second-growth shortleaf-loblolly pine and hardwoods. The values of the three cuts and a preliminary improvement cut of hardwoods for cross ties are given in table 21.

Table 21.--Value of products harvested from the farm forestry unit, Stephen F. Austin Experimental Forest, 1947-1950

Year	Products	Stumpage value	Delivered value
		- - - - Dollars	- - - -
1947	Cross ties	295.68	710.20
1948	Sawlogs, pulpwood	137.78	409.77
1949	Sawlogs, pulpwood	108.22	191.63
1950	Sawlogs	178.93	380.10
	Total	720.61	1,691.70
	Average per acre per year	2.69	6.31

The 1950 cut covered 14 acres and removed a total of 5,182 board feet (Doyle scale) or about one-fourth of the average pine volume of 1,550 feet per acre, and 5,876 board feet of upland oak or about one-fifth of the average hardwood volume of 2,060 feet per acre. The high-risk, slow-growing, defective pines and as many upland hardwoods as were merchantable were cut to improve the quality and growing conditions of the stand. Unmerchantable hardwoods overtopping pine will be girdled or poisoned early in 1951. The cost in previous years of treating 26 acres (38 stems per acre, averaging 8.6 inches in diameter breast high) was $1.42 per acre for labor and Ammate.

The total return from the 1950 cut, if figured at 1950 stumpage values, was $178.93, or $2.67 per acre for the 67-acre unit. The total return for the logs delivered at a mill was $380.10, or an average of $5.67 per acre.

Felling and bucking time of the two local farmers who cut the logs was about 81 man-hours in 1950, or a little over 7 man-hours per M feet (Doyle rule). Skidding to the roadside required approximately 19 man-team hours, or nearly 1-3/4 hours per M feet. Hauling the logs to the mill added an additional 21 man-hours, or nearly 2 hours per M feet. The total man-hours for all operations is 121.

At the Gulfcoast Branch, the results of three years of intensive forestry practiced on the four second-growth longleaf-slash pine "farm forestry forties" on the Harrison Experimental Forest show that forestry pays well. Forties #1 (40 pine trees per acre, 5 inches or over in diameter) and #2 (47 pine trees per acre) are the "poor" forties, and #3 (77 pines per acre) and #4 (173 pines per acre) are the "good" forties. The major emphasis during the first 3 years has been on sawlog harvest and turpentining. Merchantable hardwoods have been removed to favor the pine. Some poles, pulpwood, and fence posts have been sold. The value of the harvest of all timber products has averaged $1.96 per acre per year in terms of stumpage, or $4.84 in terms of delivered products, for the four forties together.

Turpentining substantially increased the returns from farm forestry. The hourly wage from gum farming is higher than that paid by pick-up jobs off the farm, and the returns per acre (table 22) compare favorably with more intensive agricultural enterprises.

Table 22.--Average annual returns per acre from turpentining four farm forestry forties on the Harrison Experimental Forest, 1948-1950

Item	Forty number				All forties
	1	2	3	4	
	Dollars				
Lease value plus P.M.A. payments	0.46	0.58	0.76	0.99	0.71
Roadside value	2.03	2.50	3.86	4.15	3.17
Out-of-pocket operating costs	.34	.42	.55	.67	.50

Gross returns per man-hour (for lease and labor) averaged 88 cents on the four forties over the 3-year period. Net returns (to labor alone) were 72 cents per man-hour.

The average man-hours required in producing various commodities (delivered at roadside) were as follows:

Product	Unit of measure	Man-hours per unit
Poles	Each	1.3
Pine sawlogs	M bd. ft. (Scribner rule)	5.0
Oak sawlogs	M bd. ft. (Scribner rule)	8.0
Dogwood bolts	Cord	16.0
Pulpwood	Cord	4.0
Fuel wood	Cord	16.0
Fence posts	100	11.3
Raw gum	Barrel	23.2

A study of biweekly bark chipping and acid stimulation in second-growth longleaf pine demonstrated that large trees yield the greatest turpentining profits per face. A stand averaging 25 years in age and 10.5 inches in d.b.h. netted $60.32 (value of gum minus all production costs) per 1,000 faces for 15 streaks. Another stand on a similar site but averaging 35 years of age and 13.2 inches in diameter netted $125.87 per 1,000 faces for the same working, despite the fact that it contained only a third as many trees per acre.

At the Tallahatchie Branch, three farm woodland units in second-growth shortleaf pine and upland hardwoods are being managed to determine costs and returns while stands are being built up. The stands generally are in a depleted condition. A different intensity of management is being applied to each unit. During the year, a 100 percent cruise was made of each unit; some cull trees were deadened; and pine, eastern redcedar, and locust were planted. Some improvement cuts were made, but only pine logs could be sold; hardwoods proved to be unprofitable and operators would not take them.

RANGE RESEARCH

Grazing Management

Seasonal grazing on forest range

Native yearling steers provided by the Mississippi Agricultural Experiment Station were turned into four forest range pastures of about 160 acres each at the McNeill Experimental Forest on March 27, 1950. On July 21, the 24 steers from two of the pastures were moved to a tung orchard, grazed there a few days, and sold for $25.50 per cwt. The average gain per head in 4 months of grazing on forest range was 92 pounds, about 0.8 pound per day. Gross return for the weight gained was $1.70 per acre.

The 12 steers on the other two pastures were removed on November 17 and sold for $21.24 per cwt. Their average weight gain during 6 months' grazing on forest range was 136 pounds each (they were removed from the pastures for a month starting September 23 because the water supply failed). Their average daily gain on the range was nearly as much as the short-season group, even though they lost weight in November. Gross return for weight gained was $1.05 per acre. This return was lower than from the short-season grazing because there were half as many steers per pasture and the market price was lower in November.

Grass production in the grazed pastures in 1950 was about 650 pounds per acre, somewhat higher than average. Only about 10 to 15 percent of the grass was utilized; thus the stocking of yearling steers could have been heavier, and gross returns increased. These results remove any doubt that there is sufficient grass for cattle under a rather well-stocked longleaf pine pole stand, and indicate real possibilities for permanently combining forestry and grazing in the longleaf-slash pine belt.

A curve of seasonal grass production on cut-over longleaf pine range in central Louisiana was developed for 1947, 1948, and 1949. Rainfall and grass growth were near average in 1947, below average in 1948, and above average in 1949. The main forage crop was produced before midsummer, and there were no practical differences in amount up to midseason during the 3 years. One-half of the grass was produced in the 11 weeks ending June 1, and over two-thirds was produced by midseason, July 7. After this date, the real differences in production came. Growth practically stopped in June of 1948; total production was 40 percent below average. But growth accelerated during July, August, and September 1949, and grass production was 40 percent above average.

This study adds to the evidence that relatively short-season grazing, starting in spring, will give the best use of bluestem ranges of the longleaf pine belt. The crude protein in ungrazed grass declines rapidly as the season advances. By May 15 the amount is usually below the minimum standard for good growth of beef cattle. However, if grazing is concentrated during a spring-summer season, the intensive cropping will help keep the forage fresh and nutritious in summer and may extend the good gaining season into August, or even later in favorable years.

Forage production

The effects of forest stands and of timber stand improvement on grass production were studied in south Alabama and in central Louisiana.

The effects of single seed trees and of timber stands on grass cover is shown in table 23 for longleaf pine areas in south Alabama. Percent of ground surface covered by grass on milacre plots is related to distance from seed tree or edge of the stand (forest wall). It appears that second-growth longleaf pine may influence grass cover for about 30 feet out from the edge of the stand, whereas the influence of single seed trees is limited to about 10 feet.

Table 23.--Grass cover in relation to distance from seed trees and forest walls

Distance from seed tree or forest wall (feet)	Grass cover	
	Seed trees	Forest walls
	- - - - Percent - - - -	
0.0	..	21
6.6	48	33
13.2	55	41
19.8	55	47
26.4	55	47
33.0	55	50
39.6	53	51
46.2	53	50
52.8	54	50

There is also considerable difference in grass density on different sites and locations. For example, the average density of the bluestem grass cover on open land on the Escambia Experimental Forest was 32 percent on poor deep sandy soils, and 52 percent on average to good loam soils. On the nearby Conecuh National Forest, on areas dominated by wiregrass, density on loamy soils ranged from 57 to 69 percent. Thus site productivity must be considered for grass as well as for trees.

On cutover longleaf pine land in central Louisiana, forage production and grazing capacity more than doubled in three seasons as a result of hardwood control. The hardwood stand was moderately heavy--it averaged about 330 stems per acre, 4.5 inches d.b.h., with basal area of 37 square feet per acre. The trees were deadened by several methods in March 1948. Cost of treatment ranged from $2.00 to $6.00 per acre (excluding a treatment in which all hardwoods were poisoned with Ammate). Grass production on treated plots increased from about 700 pounds per acre in 1948 to nearly 1,900 pounds in 1950. The 1950 production on untreated plots averaged 892 pounds. The increased amounts of grass would enable recovery of the cost of treatment from grazing alone in 1-1/2 to 4 years.

Poisonous plants

Observations were made on poisonous plants grazed by cattle on forest range in south Alabama. Crowpoison or stagger-grass (*Amianthium muscaetoxicum*) was the only poisonous plant that was heavily grazed. The winter was exceptionally mild, and by February 10, 1950, cattle were eating large quantities of young crowpoison leaves on burned areas. By April 3, crowpoison flower buds appeared and cows grazed the plant heavily on unburned areas but less heavily on burned. By April 21, flowers were open and white and major grazing of crowpoison had stopped.

Bracken fern (*Pteridium aquilinum*) was grazed early in the year on burned areas. Presumably it is not very toxic in early stages. Other poisonous plants that were grazed to a limited extent were Carolina jessamine (*Gelsemium sempervirens*) and fetter bush (*Leucothoe axillaris*). Elderberry (*Sambucus canadensis*) was grazed during the fall, when it apparently is not very toxic. Poisonous plants on which no grazing was observed were mountainlaurel (*Kalmia latifolia*), buttonbush (*Cephalanthus occidentalis*), red buckeye (*Aesculus pavia*), and purple anise (*Illicium floridanum*).

Sixteen cattlemen who run 327 cattle near the Escambia Experimental Forest reported no symptoms of, or losses from, poisoning. Since range cattle get very little attention from their owners, it is possible that there were some unobserved poison symptoms.

A few plant-poison symptoms were reported by local veterinarians. All cases involved exceptional circumstances--in one instance, the animal had eaten poisonous ornamentals, and in another, the livestock had been confined to a small, weedy enclosure.

Feeding winter supplements to cattle on forest range

A breeding herd of beef cattle grazing forest range in central Louisiana was divided into three groups and given supplemental feed for three winters. The levels of supplemental feeding were 1.7, 2.5, and 3.3 pounds of cottonseed cake daily per animal unit for about 90 days each winter. There was very little difference in production and net income between the high and low level groups. The group on intermediate ration was distinctly lowest in production; its calf crops were low and death losses high.

Production in the experimental herd for the 3-year period averaged 151 pounds of beef per cow. The calf crops averaged 50 percent and calves weighed about 240 pounds at 6 months, barely better than range herds that receive very little supplemental feed. Net income per cow averaged $8.80 after $9.48 was deducted for supplemental feed and $6.00 for other operating expenditures.

Nutritive analyses of feed and forage indicate that the ration of 1.7 pounds was adequate for reasonably good nutrition if each cow grazed at least 13 pounds (dry weight) of grass daily. However, the 90-day feeding period was too short. Weight losses were heavy in late fall and cows were in rather poor condition before feeding started.

The advisability of a longer feeding season was demonstrated during the last year of the study. The herd was in such poor condition in the fall that supplemental feeding was started a month early and was continued until spring. Nearly every animal came through the winter in good condition. Then, with the help of an above-average summer, calves at 6 months averaged 336 pounds, as compared to 218 and 200 pounds for the 2 previous years.

Grazing damage to pine reproduction

Thirty percent of the slash pine seedlings planted on 4,000 acres in La Salle Parish during the winter of 1948-1949 were grazed early in 1949 by range cattle. Most of the pine grazing occurred in January, February, and March, when green grass was scarce. In the fall of 1950, after two growing seasons, results were:

1. Grazing reduced height growth. Ungrazed trees averaged 21 inches in height, grazed trees 16 inches. The difference is statistically significant.

2. Grazing did not increase seedling mortality. Survival for all trees was 79 percent, with no significant difference between survival of grazed and ungrazed trees.

3. Cropping of terminal buds did not produce double or multiple leaders. On 96 percent of the grazed trees, a single lateral branch has grown upward from within a foot of the ground and replaced the original terminal shoot. The only damage was the reduced height growth indicated above.

Although the grazing did not increase seedling mortality or damage tree form, the reduction in height growth alone dictates that pine plantations need protection from winter grazing until the growing tips are above the reach of cattle.

Control of Undesirable Hardwoods

Eight formulations and mixtures of 2,4-D and 2,4,5-T were compared to Ammate in exploratory tests of new chemicals and methods. The tests were installed on blackjack oak in central Louisiana in May 1950. All chemicals, except Ammate, were mixed with enough Diesel fuel to make 4 percent solutions, 2,4-D acid equivalent. The chemicals were applied by five methods--cups, frills, stumps, Cornell tool, and spraying to wet the lower 18 inches of the tree trunk. Tentative results are:

1. Effective tree crown kill and little or no sprouting so far were obtained from all methods by using (a) butyl ester of 2,4,5-T, (b) mixture of the butyl esters of 2,4,5-T and 2,4-D, (c) isopropyl ester of 2,4-D, and (d) mixture of the butoxy esters of 2,4-D and 2,4,5-T.

2. The Cornell tool and trunk spray methods appear to be as effective as cupping or frilling, which require ax work and are more hazardous.

3. Cost of applying a 4 percent solution of isopropyl ester of 2,4-D with Cornell tool is the same as applying a 32.4 percent solution of Ammate in frills--about 1.5 cents for a tree 5 inches d.b.h. Trunk spraying was more expensive than other methods, but a sprayed band less than 18 inches or a weaker solution may be effective and costs less.

Artificial Revegetation

Range nursery trials

Fourteen grasses and legumes that have shown good possibilities for range improvement in other parts of the South were planted in a range forage nursery near Alexandria, Louisiana, in March 1950. The plantings are to be protected from grazing to see if they survive, grow, and reproduce in the climate and soil in this longleaf pine area. Additional plantings of winter-growing species were made in October 1950.

The most successful of the summer-growing species so far are hairy indigo (*Indigofera hirsuta*), sericea lespedeza (*Lespedeza sericea*), and yellow bluestem (*Andropogon ischaemum*). These plants produced good stands when planted on fertilized, disked seedbeds. Hairy indigo, an annual legume, produced an exceptional volume of herbage and a big crop of seed. Yellow bluestem and sericea lespedeza came up to good stands and grew well. It will take several years to evaluate these plants--they may be crowded out by native species.

None of the seeded species were established on unfertilized range. Some cultivation appears necessary for most seeded species--it reduced first-year competition by native species. Also, burned, uncultivated soil dried out and baked in warm, dry weather.

Establishing and grazing firebreaks

A dense carpet grass sod was formed in one growing season on strips of forest land that were disked, fertilized with 1,000 pounds of basic slag per acre, seeded with carpet grass and common lespedeza in April 1949, and then grazed by cattle the entire season. Such a sod makes a reasonably effective fire barrier if kept closely grazed.

To find the least expensive method of establishing grazed firebreaks, a similar study was installed in March 1950 on plots on the Palustris Experimental Forest. This study was designed to compare: (1) a mixture of Bermuda grass and lespedeza with a mixture of carpet grass and lespedeza; (2) disking with harrowing, and no cultivation, all on burned range; and (3) 500 pounds per acre basic slag with 1,000 pounds. The experimental area was fenced to control grazing. A good stand of common lespedeza was obtained from all treatments, but none of the treatments gave good stands of carpet grass or Bermuda grass in the first season. The fenced area of 2.5 acres was grazed by 2 to 6 milk cows from May 12 to October 2, 1950, or an average of one cow per acre for 4.5 months. The dairy farmer was pleased with the milk production of these cows. There is no clear reason why a carpet grass stand failed to develop in 1950 as in 1949. The 1950 costs on small plots ranged from $15 to $24 per acre. This is equivalent to $60 to $96 per mile of firebreak averaging 33 feet wide.

The use of green firebreaks was explored in south Mississippi in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering. In December 1949, a firebreak 100 feet wide and 0.5 mile long was seeded with 3 pounds of big trefoil per acre. Before seeding, the entire area was burned and half was disked. Four hundred pounds of superphosphate and 100 pounds of muriate of potash per acre were broadcast on the entire firebreak, which was fenced to control grazing. Site preparation and seeding cost $21.30 per acre with disking, and $16.80 per acre with no disking. A satisfactory stand of trefoil was established by spring; the stand was more uniform on the disked surface. After making excellent growth early in the summer, it matured and died back. New growth, starting in the fall of 1950, continued through the winter. Part of the test area was grazed by calves in the spring and summer of 1950. They kept down the native grasses, thus reducing the amount of fuel that would accumulate under no grazing. They made better weight gains than yearling steers on native forest range.

In a firebreak test in south Alabama, none of the fertilizer applications stimulated grazing on native grasses appreciably in more than 2 years since application. Suggested reasons for failure include high phosphorus-fixing capacity of local soils, lack of nitrogen, or both. On the other hand, small plots that were plowed, fertilized, and seeded on slope and swale sites made good firebreaks again the second winter after establishment, but test proved that fire would creep across the slope plots on average dry days. Both carpet grass and Pensacola Bahia grass made good breaks on these sites, even though wild carpet grass crowded out much of the Bahia grass in the swale. On the ridge (deep sand) site, the carpet grass in 1950 made a better firebreak than Pensacola Bahia, a reversal of 1949 conditions. Sericea lespedeza maintained itself on all plots. There was also much more accumulated grass growth, especially of Pensacola Bahia, in August than in midwinter. Apparently cattle grazed the plots in preference to native grasses during the fall and early winter.

FOREST UTILIZATION SERVICE

The Forest Utilization Service at the Southern Station continued to operate as a liaison between the U. S. Forest Products Laboratory, other forest-products and utilization research groups, and the timber growers and wood-using industries of the South.

Hardwood Sawlog Classes and Grades and Grade Yields

Two training meetings on the use of hardwood log grades were held in 1950. Total attendance was 38. These meetings were sponsored by the Mississippi National Forests and Louisiana State University. They bring the number of such meetings to 16, with a total attendance of 317.

The field work was completed on the study of lumber grade yield from hardwood logs. This study is being made in cooperation with the Tennessee Valley Authority. The major objective is to obtain additional data on the relation of log classes and grades to lumber grade yields for southern hardwoods. Information on time requirements, amount of labor, type of equipment, and methods of sawing was also gathered. Work was carried on at 68 randomly selected small sawmills scattered over the entire Tennessee Valley, and data were taken on 7,469 hardwood logs, mainly the oaks and yellow-poplar.

The field work was completed on the first phase of a cooperative utilization study with the Texas Forest Service. The main objective of this phase of the study is to determine the yields of standard factory lumber from low-quality hardwood trees and logs in upland stands of mixed pine and hardwoods in east Texas. It was planned to study 150 logs in each of the following use classes: grade 3 factory lumber logs, tie-and-timber logs, and local-use logs. Within each use class there were to be 50 logs (10 in each of five diameter groups) from each of the three most common hardwood species in the area: red oak, post oak, and sweetgum. The logs were sawed and the graded lumber yields were determined. Somewhat more logs--529 in all--were secured than the plans called for.

The publication, "Log Defects in Southern Hardwoods," was released as U. S. Department of Agriculture Handbook No. 4. Included are detail photographs of log defects and their effects under the surface. All abnormalities on the surface and ends of logs are defined and identified, and their significance is evaluated in relation to three classes of logs.

Wood Seasoning

Seasoning lumber in unit packages

In cooperation with the Forest Products Laboratory, preliminary field work was begun on the study of air seasoning and mechanical handling of lumber in unit packages. This study is part of a nation-wide investigation. Seventeen operations handling lumber in unit packages by mechanical means were visited in Tennessee, Mississippi, Louisiana, and Arkansas. In general, these firms were thoroughly convinced of the advantages of mechanical handling. Mechanical handling of lumber in unit packages is replacing hand-piling methods in the South. There is, however, a wide variation in certain practices such as the use or non-use of covers for piles, and flat versus slope piling. Studies are needed on the advantages and disadvantages of these practices as they affect costs, degrade, labor, and over-all returns.

Kiln-drying

Accelerated schedules for green oak.--In cooperation with Mississippi State College and the Mississippi Products Company, Jackson, Mississippi, an experimental run of 5/4 and 4/4 green oak was made in a pilot kiln to determine the amount and seriousness of degrade from accelerated kiln schedules. With schedules ranging from 110° F. dry bulb - 100° F. wet bulb to 180° F. dry bulb - 130° F. wet bulb, the stock was reduced to 20° moisture content in 9 days. Preliminary results indicated that for the precision drying required by the Mississippi Products Company this accelerated schedule produced excessive kiln damage. For less precise drying and where resawing is not practiced, considerable kiln time can be saved with accelerated schedules.

Hickory handle-stock.--In cooperation with the Forest Products Laboratory and Mississippi State College, a study was made to determine the degree of pinking in hickory handle-stock dried under various kiln schedules. There was no significant difference in the pinking characteristics of the various species of hickory studied. A mild or conservative kiln schedule was successfully used to produce stock with a small amount of pinking. A faster schedule was developed for stock in which pinking was not considered a defect.

Gas-fired kilns.--Final reports for the cooperative check runs of the Russell and Risser gas-fired kilns were completed by the Forest Products Laboratory and sent to the cooperating agencies. The Russell kiln, drying flooring oak up to 40 percent moisture content, started with temperatures of 150° F. and increased to over 220° F. by the fifth day. These severe drying conditions are not recommended practice, but because of unusual conditions the cooperating flooring company was willing to accept the 6 percent loss from honeycombing.

A Risser natural-draft gas-fired kiln was operated more conservatively for drying air-seasoned sap gum for core stock. Temperatures started at 130° F. and increased to over 200° F. within 102 hours. A small steam laundry boiler was used in an attempt to condition the lumber by steaming, but it had little effect on the relative humidity. This charge was rather uniformly dried to the extremely low moisture content of 3.3 percent with no honeycomb damage. Practically all of the samples were casehardened, but this was not considered as degrade.

Some of the larger companies with steam kilns and steam available are now installing gas-fired kilns. They report fuel costs of less than 40 cents per thousand board feet of lumber dried. There are also considerable savings in labor.

Parana pine.--The large volume of parana pine being imported from South America has brought a considerable number of requests regarding means of kiln-drying it. Millions of feet of this species are now reaching this country, largely because British imports have been seriously reduced.

The normal wood of parana pine offers no serious problem in drying or conditioning. Chiefly because of growth characteristics, however, this species develops a considerable amount of compression wood. It is this wood (which shrinks longitudinally) that is giving the most trouble from warp and twist, and very little can be done to eliminate the difficulty. A rather mild schedule (like that for hardwoods), followed by a drastic conditioning treatment, gives the best results. To avoid excessive sag, the lumber must be well piled and stickered, with additional bolsters used between unit packages.

Wood Waste Utilization

The study on amounts of chippable waste available at pine sawmills, made cooperatively with the International Paper Company, was reported in Occasional Paper 115. Several additional items of information are being developed from data gathered during the study. The weight per MBM Doyle scale of green, peeled pine logs ranged from approximately 22,000 pounds for the 8-inch diameter logs to 12,500 pounds for the 12-inch and a little less than 8,000 pounds for the 26-inch diameter logs. The average moisture content for all logs included was 102.05 percent, indicating that approximately half of the total log weight is water.

Wood Preservation

Coordinated fence post preservation study

The coordinated fence post preservation project includes the Forestry Investigations Branch of the Tennessee Valley Authority, Alabama Polytechnic Institute, Mississippi State College, University System of Georgia, University of Tennessee, and Virginia Polytechnic Institute. To date, over 1,558 fence posts of 14 different species have been treated and installed in service tests according to standardized procedure. Approximately 900 untreated controls have also been installed. Another 6,500 fence posts have been prepared for treating. The cold-soaking method of treatment, using pentachlorophenol and copper naphthenate solutions, has been used.

A study was made of 2,000 fence posts (mixed Delta hardwood species) treated by farmers using the hot and cold bath. Results indicated that round posts averaging 3½ inches in diameter could be treated for 36.7 cents per post. An average absorption of 6-3/4 pounds of 5 percent solution of pentachlorophenol was obtained.

Decay and termite damage to houses

Cooperating with the Housing Authority of New Orleans, the Forest Utilization Service investigated termite and decay damage in several low-rent housing projects in New Orleans. There are seven large projects, with possibly 300 buildings involved. These brick structures built on a concrete slab are seriously infested with termites,and because of the type of construction normal means of control are not adequate. A more detailed study was recommended for the Bureau of Entomology and Plant Quarantine, Gulfport, Mississippi.

Wood Molasses

A wood hydrolysis conference was held at Knoxville, Tennessee, by representatives of the Tennessee Valley Authority and the Forest Utilization Service units of the Central, Southeastern, and Southern Forest Experiment Stations. An 8-point course of action for the pilot plant operation, 1951-1953, over and above the production of sufficient molasses to meet the proposed feeding tests,was tentatively approved.

Feeding tests of wood molasses were arranged with two departments of the Texas Agricultural Experiment Station, Texas A and M College. The Animal Husbandry Department will compare wood molasses, corn molasses, citrus molasses, dried molasses, and blackstrap molasses with ground sorghum grain as a fattening ration for beef cattle. The Dairy Husbandry Department will determine the comparative feeding value of wood molasses with milo grain in rations for dairy cows.

Effect on milk production, flavors and odors in the milk, water consumption, and general health of the cows will be considered. Four tons of hardwood molasses will be furnished from the Forest Products Laboratory-Tennessee Valley Authority pilot plant at Wilson Dam, Alabama.

Fence Post Barking Machines

In connection with the revision of the fence post barking bulletin, five new types of barking machines were observed and checked. Several portable barking machines that show considerable promise for both fence posts and pulpwood bolts will be described in the publication.

FLOOD CONTROL SURVEYS

Surveys to formulate watershed improvement plans in aid of flood control went forward on an accelerated schedule during 1950. Major activities centered on agency review and clearance of the survey report for the White River watershed above Norfork, Arkansas; and on expediting surveys of the Ouachita River watershed and the remainder of the White River basin.

An important development affecting survey activities was the creation, in July, of a Federal-State Inter-Agency Committee which is to prepare a comprehensive resource development plan for the combined Arkansas, White, and Red River basins. Represented on the Committee are six Federal agencies--Corps of Engineers (Chairmanship), Interior, Agriculture, Commerce, Federal Power Commission, and Federal Security Agency--and the Governors of the eight States. The Inter-Agency study is going forward on an ambitious 2-year schedule, and the Station's Flood Surveys will contribute importantly to it. The survey program has been reoriented to give priority consideration to work in the Basin. The survey of the Homochitto River watershed (Mississippi), which has been in the early report-preparation stage since early 1950, had to be deferred indefinitely.

A continuing job during the year was revision of the survey report for the Upper White River watershed. New policies and procedures necessitated major modification of recommended measures to reflect probable rates of accomplishment under going conservation programs and to reconcile agency estimates as to quantities and costs of proposed measures. Involved were numerous conferences with consulting agencies, chiefly the Soil Conservation Service, Production and Marketing Administration, Extension Service, and the Bureau of Agricultural Economics. Other Federal and State agencies at the field level also reviewed the report and by year's end it was undergoing study in Washington, preparatory to final review by agencies represented on the Federal Inter-Agency River Basin Committee.

Field work on the Ouachita survey was substantially finished in November. Completed were land classification surveys; mapping of valley cross-sections for use in relating flood stages to areas of overflow; appraisal of floodplain damages from sedimentation, scour, and channel erosion; reconnaissance sedimentation surveys of Lake Winona and Lake Hamilton; forest land classification to ascertain watershed condition and to obtain related data on cover soils, fire occurrence, and the like; and engineering studies to determine need and justification for small detention reservoirs for the reduction of flood damages. Analysis of remedial needs and evaluation of costs and benefits were also well advanced by the end of the year.

Analysis of the Ouachita data indicates that flooding and related damages are substantially less in this watershed than in contiguous territory. This is in part attributable to the limited agricultural development of floodplain lands, many of which are in poorly drained forest. It also reflects evident betterment of watershed cover in recent years as a result of major shifts in land use, improved fire protection, and other factors. A substantial acreage of the mountain headwaters is in national forests which have had good protection and management for several decades.

The schedule for the Lower White survey was stepped up sharply to enable completion of this project within the time limits for the Arkansas-White-Red Inter-Agency study. Much field work was accomplished during the fall months, including engineering surveys of valley and channel cross-sections, mapping of erosion and sediment damage on floodplain reaches and samples, and classification of forest lands as to watershed condition. Development of sampling procedures and other advance planning will permit an early start on land classification surveys for the Missouri portion of the watershed, where available basic data are limited.

Contributions to Forestry Phases of Soil Conservation Service Projects

Flood control surveys for which the Soil Conservation Service has major responsibility required continuing assistance on forestry phases. During the year, Station personnel participated in nine of these surveys in varying stages of completion. Contributions included critical review of four survey reports and follow-up revision of forestry program recommendations, and field activities and data analysis to provide basic information for five going surveys.

Much work went into revamping forestry portions of survey reports for the Grand-Neosho, Lower Arkansas, Brazos, and Savannah River watersheds to conform with new policies and procedures. In large part, this required entirely new appraisals of watershed treatment needs and refinement of earlier estimates of needed measures, costs, and probable benefits. The work involved many conferences with State Foresters and others, additional field reconnaissance to study forest ownership and other special problems, and preparation of new drafts of report material. All of these reports were in advanced stages of review and clearance by the end of the year.

Station personnel also assisted the Soil Conservation Service on surveys now under way in the Altamaha-Ogeechee watershed (Georgia and South Carolina); Apalachicola River (Georgia, Alabama, and Florida); Trinity-San Jacinto Rivers (Texas); Red River below Dennison Dam (Texas, Oklahoma, Louisiana, and Arkansas); and the Cross Timbers portion of the Upper Arkansas River basin in Oklahoma. A principal contribution was the completion of forest land classification surveys to provide basic information for gaging rates of runoff and sediment production from forest lands--present and future. Accomplishments also included much work in formulating forestry programs for the Lower Red and Upper Arkansas watersheds, both of which figure conspicuously in the plans and schedule for the Inter-Agency study.

Related Activities

Various activities in related fields of land and water resource planning required the participation of flood survey personnel. Some of this was of a service nature. Technical advice and assistance was furnished the Corps of Engineers in evaluating the effects of flooding on timber values in the Little River basin (Arkansas and Oklahoma) as a part of an economic appraisal of alternate reservoir plans. Hydrologic data were made available to the Soil Conservation Service for use in planning channel protection works in the Homochitto watershed. Flood damage data for specific watersheds were also supplied other agencies.

As a Forest Service contribution to the work of the President's Water Resources Policy Commission, a report was prepared on forest problems and program needs in the Arkansas-White River basin.

Station personnel also participated in organization meetings and public hearings of the Inter-Agency Committee which is to prepare the comprehensive resource development plan for the Arkansas-White-Red River basin; and also served in an interim capacity on the Field Committee which is assisting the Department representative in agricultural phases of the basin plan.

Some Survey Findings

The flood surveys afford much opportunity for application of research information in appraising water-land treatment relationships and in dealing with other evaluation problems. They also develop new data which considerably extend research knowledge in these fields.

Field inventories, completed in six major drainage basins, show that little of the South's forest land, despite notable forestry advances in the last two decades, is in satisfactory condition for water absorption and storage (table 24). In the respective basins, only 1 to 4 percent of the forest land is in good watershed condition; and, in most instances, from two-thirds to three-fourths is in distinctly poor condition, as indicated by scanty ground cover, sheet erosion, and other evident damage. Litter and humus development were the main criteria in classifying these lands, since these reflect rather accurately capacity to absorb and retain water as revealed in infiltration tests and other measurements.

Table 24.--Forest lands classified as to watershed condition[1]

River basin	Good	Fair	Poor
	Percent of total forest land		
Altamaha-Ogeechee	2	21	77
Apalachicola	2	25	73
Ouachita	4	55	41
Lower White	1	30	69
Trinity-San Jacinto	1	25	74

[1] Based on field inventory and inspection of approximately 3,570 sample plots.

Although it is evident that watershed values have been badly impaired on most of the South's forest lands, there are also favorable aspects. The field inventories afford definite evidence that appreciable quantities of protective forest litter and humus can be developed even in the scrub woodlands of Texas and Oklahoma. Since the requirements for "good" condition approximate those observed in stands which have 20 years or more of protection and care, it is probable that several decades of good management will largely restore watershed values on the bulk of the land. On the other hand, since litter and humus accumulate in lesser amounts than in more northerly latitudes, a relatively long period will be required to put the lands in optimum condition.

Another finding of some significance relates to observed depths of mineral soil in the rough forest lands of the Ouachita Mountains region. A commonly held view among hydrologists has been that this is an area without well-developed soils and hence affords negligible opportunity for water storage. In effect, this would mean that land treatment or cover improvement measures are of little practical benefit in reducing or regulating runoff. Soil borings made in connection with extensive field sampling of the Ouachita Mountains region show this assumption to be unfounded. On about two-thirds of the mountain area, mineral soil averaged 20 inches or more in depth, and on only 5 percent was it classed as shallow, i.e., 10 inches or less. Soils of this depth and character have a substantial storage potential when water content is below field capacity, and hence are an important factor in water yield and regulation.

EXPERIMENTAL FOREST DEVELOPMENT

Alexandria

A supplemental establishment report for the Palustris Experimental Forest was approved by the Chief's Office. This document eliminated the Clear Creek and Dry Prong Tracts and added 800 acres adjacent to the Johnson Tract and 5,800 acres in the Longleaf Tract to the Palustris Experimental Forest.

Three storehouses and 7.1 miles of graded road were constructed on the Longleaf Tract in 1950. Installations were made for three studies: a range forage nursery, a 3-acre exclosure for testing grazed firebreaks, and a fence around 20 acres of a controlled hog-damage study.

Birmingham

During 1950, cutting on the Flat Top Experimental Forest was maintained at about the normal pace. All study plots involving cutting were treated. It has been increasingly difficult to maintain even a small crew on cutting operations. Expenses have increased and the product specifications have become more severe. Hardwoods that were merchantable a few years ago cannot be cut under present conditions. Consequently, it would appear that poisoning and girdling will become increasingly important in this area.

Brewton

Physical improvements were again limited by lack of funds. However, Station personnel relocated one-half mile of road in the eastern part of the forest and the new road was built by the Escambia County road department.

Brownspot infection became severe on longleaf seedlings on parts of the forest during late 1949, and 793 acres were prescribe-burned in February 1950.

Hog damage to longleaf seedlings was very serious on the Escambia Experimental Forest in the spring of 1950. Electric fences proved difficult to maintain and failed to protect seedling plots. Consequently, a trapping program was started in early June. Results so far indicate that this program may reduce seedling damage somewhat, but it is expensive and ultimately a hog-proof fence will be needed around the entire forest.

Central Ozarks

A topographic map and a detailed soil survey of the Koen Experimental Forest were made during 1950. Compilations of inventory data were completed, with individual tenth-acre subdivisions classified according to location, exposure, degree of slope, reproduction status, forest type, degree of stocking, and merchantability. Detailed maps of underlying rock structure, soils, topography, forest type, stocking, and merchantability condition were also prepared. An establishment report for the experimental forest was completed and a road construction plan was prepared. Entrance and individual study signs were installed. The area was formally dedicated on September 8.

A four-man crew is doing timber stand improvement work on approximately 2,500 acres of the Sylamore Experimental Forest. To facilitate the work, the area was first mapped and classified by sites.

Crossett

All planned remeasurements of old studies and installations of new studies were completed on schedule. Timber stand improvement work was completed on 440 acres of the pine land on the Crossett Experimental Forest. The 1950 harvest of forest products from the forest amounted to 1,213,000 board feet of logs (Doyle-Scribner scale), 1,303 cords of pulpwood, and 77 units of acidwood. These products had a stumpage value of approximately $45,700.

Delta

A commercial stand improvement cut was made on 192 acres of the Delta Experimental Forest. Fence posts and firewood have been salvaged on one forty, principally from jump butts and tops of trees felled for sawlogs. Despite considerable use of the roads by log trucks, little time was spent on the maintenance of the Forest. Signs were installed at entrances and plot locations.

East Texas

Timber management on the Stephen F. Austin Experimental Forest was purposely delayed until experimental areas were established. Because the area was largely understocked, there was little need for early cutting of pine. A cut of tie logs in 1947 and later cuttings in connection with the hardwood utilization study have removed much of the usable hardwood.

Plans for placing under management those parts of the forest not in study plots were outlined, and areas most in need of timber stand improvement work were selected for treatment early in 1950.

Gulfcoast

The proposed management plan for the Harrison Experimental Forest has been simplified. An improvement cut on non-study areas will be made beginning in 1951. Provisions have also been made for a large-scale demonstration of the effects of fencing versus open-range grazing and use of fire versus fire exclusion. Progress on the improvement cutting to date has been slow because the time cannot be taken from going studies.

Tallahatchie

The Tallahatchie Experimental Forest, in the Holly Springs National Forest, was approved and set aside for research on April 12, 1950.

During the year, new aerial photographs of the forest were obtained and detailed plans made for planting eroded and open areas. Surveys were run for the purpose of locating sample plots and camera points on the forest map. Fifteen thousand redcedar and 4,000 white pine seedlings were planted in old fields. Demonstration plantations of several other species were also made along McClelland Ridge and Forest Service Road #603.

Administrative arrangements were made to obtain the use of U. S. Engineer Department land within the experimental forest boundaries for research work.

COOPERATING AGENCIES

Bureau of Plant Industry, Soils, and Agricultural Engineering

Tree pathology

Fusiform rust of southern pines.--Several studies in Mississippi have yielded strong experimental support for the earlier observation that rust damage can be greatly reduced by maintaining high stand densities. In a slash pine plantation established in 1941, survival in 1950 was 51 percent, or 1,049 trees per acre, for 4.6 x 4.6 foot spacing, as compared to 41 percent, or 206 trees, for 9.3 x 9.3 foot spacing. Stem cankers that had originated from branch infections were present on 18 and 38 percent of the trees in the close and open spacings, respectively. One-acre plantings of slash pine, established in an area of fairly high rust hazard at spacings of 4 x 4, 5 x 5, and 6 x 6 feet, showed approximately 40 percent of the trees infected after less than 3 years in the field. Such infection in the 6 x 6 foot spacing, along with mortality from other causes, left only about 500 healthy trees per acre at this early stage in the life of the plantings, in contrast to almost 1,200 healthy trees for the closest spacing. In a final study, a plot thinned for pulpwood about 2 years previously showed 22 percent of the remaining trees with new cankers, as compared to 8 percent in the unthinned plot.

A native "south Florida" strain of slash pine and one from Cuba showed striking rust resistance and susceptibility, respectively, in geographic seed source plantings. In a south Mississippi planting, for instance, the infections after 2 years in the field are 4 percent (south Florida) and 66 percent (Cuba), as compared to 20 and 24 percent for north Florida and Mississippi strains. The south Florida strain differed greatly in growth characteristics and appearance from all other collections of slash pine within the United States. A number of these other native strains, in several plantings ranging from 3 to 7 years old, have not yet revealed any marked differences in rust resistance.

In the first test to be reported for loblolly pine, seedlings that originated from healthy parents showed 18 percent infection in comparison to 21 percent for those from cankered parents. Additional results for several slash pine plantings, 2 to 5 years old, likewise gave little promise that the rust hazard would be greatly reduced by limiting seed collection to healthy trees.

Cooperative tests at the Alabama State Nursery indicated that the effectiveness of sprays was not influenced appreciably by type of bed mulch. A recommended spray of Fermate plus Santomerse S reduced rust infection to less than 1 percent for plots with burlap, pine straw, or sawdust as mulches. Unsprayed plots ranged between 8 to 11 percent infection. In an attempt to improve spray treatments in tests at the W. W. Ashe Nursery, Duponal proved of promise as a spreader and sticker, at one-half the amount that is ordinarily used for Santomerse S. Materials of the Fermate and Zerlate type were again superior to Bordeaux mixture, but a closely related new product, manganese ethylene bis-dithiocarbamate, was less effective.

Brownspot control by spraying.--Work on control of brownspot by spraying was revived because of (a) the possibility that newer treatments would prove more efficient than the standard Bordeaux mixture, (b) the suspicion that Bordeaux and certain fertilizers anticipated for use might be incompatible and therefore cause foliage injury, and (c) the desirability of having one spray material serve for both brownspot and rust control instead of the two now recommended. Starting in May, trials of several fungicides and spreader-stickers were made on fall-sown longleaf at the Ashe Nursery. Standard Bordeaux was used for comparison. At the time of the seventh spray application in December, it was evident that all treatments had effectively controlled the disease. Included in these treatments were Ferradow, Zerlate, and Fermate in mixture with either Duponal or Santomerse S, as well as a modified Bordeaux mixture in which the copper sulphate content had been reduced from 4 to 2½ pounds per 50 gallons of spray solution. Needle killing by the disease in control plots varied from 1 to as high as 35 percent. In another series, three applications of ammonium nitrate, each at the rate of 35 pounds per acre, resulted in some killing of needle tips, probably from chemical burn. Since differences were not yet apparent at the end of the year, these various treatments will be continued on the same plots during 1951.

New diseases.--A cooperative survey with the Arkansas Resources and Development Commission disclosed the oak wilt disease in six northern counties in Arkansas. The southernmost location for the disease was near Booneville, in Logan County. Except for two small areas of infection that apparently were 2 to 3 years old, the remaining infection points were cases of single trees in an active wilting stage. The evidence in such locations was that infection had taken place in 1950.

A twig and branch canker disease of pine, suspected to be caused by Atropellis tingens, was reported to be prevalent in southeastern Oklahoma. If Atropellis is the cause, abnormal weather conditions probably resulted in a temporary flare-up of the disease.

Nursery diseases.--The first large-scale use of soil fumigation with ethylene dibromide to control the root rot at the Ashe Nursery was made on approximately 15 acres treated in the spring and later sown to longleaf, loblolly, slash, and shortleaf. Satisfactory disease control was obtained in the beds lifted to date.

Fall versus spring fumigation with ethylene dibromide, followed by spring sowing of longleaf and loblolly, demonstrated the fall treatment to be less effective. When necessary, fall treatment will probably be satisfactory if at least 32 gallons per acre of 20 percent (by volume) ethylene dibromide is used.

Rates of 16, 24, and 32 gallons per acre of 20 percent (by volume) ethylene dibromide applied in the spring, and the plots later sown to loblolly, showed the two lower rates to be less effective in root rot control than the higher rate but still better than fall treatment with the 32-gallon rate. Thus if the practice of spring treatment can be followed, the rate of 24 gallons per acre would probably be satisfactory.

The carry-over effect of previous years' treatment with ethylene dibromide on disease control was tested on consecutive spring-sown crops of longleaf, loblolly, and shortleaf pine. Some element of control was retained with the second crop after treatment but in insufficient degree to be practical. These trials were the first in which the effects of root rot were observed on shortleaf seedlings. In untreated areas, there was high mortality and a stunting of the living seedlings.

New materials tested this year were chlorobromopropene, Terrafume 40, and Dowfume W-85. The former, at 30 gallons per acre, gave only approximately 50 percent control of the root rot, whereas the latter two materials, both forms of ethylene dibromide, gave excellent disease control. Dowfume W-85, a concentrated form of the chemical, affords appreciable savings and will be used commercially at the nursery in 1951.

Field survival of badly diseased longleaf seedlings was 8 percent, as compared to 77 percent for disease-free seedlings after 1 year. Similar data for slash pine was 72 percent for the diseased and 84 percent for the healthy--an indication that in field plantings, as in nursery beds, slash pine is much more tolerant of the root rot. Seedlings treated with ethylene dibromide have consistently survived in field plantings as well as or better than disease-free untreated seedlings.

Products pathology

Building decay studies.--Surveys, partly financed by the Housing and Home Finance Agency, were made to determine decay hazards in crawl spaces and exterior woodwork of buildings in the Southeast. The crawl-space survey showed that foundation vents equalling half the area commonly recommended usually were sufficient to prevent winter condensation on sills over a wet soil. Exceptions were brick-veneer and stucco-covered frame houses in which wet crawl-space air had direct access to the brick or stucco in the wall. Condensation formed on the cool masonry and ran down, wetting the sills or headers. Condensation was found where a wet soil existed and vents were absent or closed. In one building such condensation was stopped by covering the soil with 55-pound roll roofing.

An extensive survey of some 1,500 buildings in eight southeastern States confirmed the previous findings that most serious siding decay is associated with (1) butt joints of siding to trim, (2) the use of non-breathing sheathing papers, and (3) little roof overhang. Trim placed over the ends of drop siding was safer than the usually recommended butt joints. Serious siding decay was not common even in buildings having the features associated with serious decay. Also, most serious decay was found in buildings less than 5 years old and seldom continued after major repairs were made. These observations, plus what information could be secured on the seasoning history of the siding inspected, suggested that incipient decay infections before construction were prerequisite to serious decay development. These infections apparently continued to develop when structural features permitted rain seepage and hindered drying.

Field tests of the effectiveness of oil-carried preservatives applied by brush, dip, and short-period soaks have now been under observation up to 9 years. The limitations as well as benefits of such applications in decay control in buildings are becoming clearer. Brush and dip treatments have afforded only surface protection. When southern pine sapwood so treated was left unpainted and exposed off the ground to rainwash, internal decay developed. Presumably this followed checks through the treated shell. In laboratory trials, only pine with fungus infections showed good penetration of oils unless soaking was for periods too long to be feasible for most on-the-job use. Brush and dip applications of pentachlorophenol and copper naphthenate have continued to give protection when the test units were painted. Soaks of 15 minutes or longer have afforded almost complete protection for 9 years. In the one test in which it was included, 0.2 percent phenyl mercuric oleate applied as a 30-minute soak permitted heavy decay in 8 years, while phenol-treated samples remained decay-free. When paint failures due to moisture accumulations are considered in addition to decay control, preliminary tests suggest that the addition of a moisture repellent to an oil-carried preservative would be of particular benefit for siding ends and exterior trim.

Mold stimulation in relation to decay and permeability of pine.--Spray or dip treatments with 3 to 4 percent solutions of ammonium or sodium fluoride resulted in heavy development of a green mold (Trichoderma) on and in green round and sawn products of pine. Although colored on the surface, such treated wood remained exceptionally free of stain and decay in the interior, even after long storage periods. It also proved strikingly permeable to oil and water solutions; penetration and absorptions usually were four-fold or more those obtained in untreated wood. Whether the fluorine treatments actually stimulated mold development, and whether the mold increased permeability and also was antibiotic to both decay and stain fungi, are now being investigated.

The possible beneficial effects of such a treatment are: (a) deterioration during seasoning or storage might be reduced in posts, small poles, and pulpwood; (b) the preservative treatment of posts and small poles might be greatly facilitated; and (c) cooking schedules might be shortened and the uniformity of cooking yields improved in pulping operations. One disadvantage has been that molded wood stored in the open proved so permeable to water during rains that penetration of oil preservatives was impeded rather than facilitated for a period thereafter. Storing under cover after mold had developed would avoid this difficulty, but there are practical limitations to such storage. Since mold infection commonly occurs on wood without fluorine treatments, it probably explains some of the variable results obtained in treating operations.

Pulpwood deterioration.--The following summary of results concerns work done in cooperation with the Gaylord Container Corporation, International Paper Company, and Masonite Corporation, and in independent tests at the Harrison Experimental Forest.

Unpeeled pulpwood stored in spring or early summer was reduced 6 to 8 percent in specific gravity after 4 months of storage. Such reductions were 2 to 3 times greater than those after 4 months of late fall or winter storage. After 9 to 12 months, specific gravity losses ranged between 10 and 15 percent, regardless of when storage started. Loss of water from the bolts was so slow that conditions continued favorable for decay even after 1 year of storage. Decay and reductions in specific gravity and moisture content all were greater for (a) bolts of small as compared to large diameters, and (b) the ends of bolts as compared to the middle part. They were also somewhat greater in loblolly than in slash or shortleaf pine.

Peeled pulpwood deteriorated more rapidly than unpeeled wood during the first 2 to 3 months of summer and 4 to 6 months of winter storage. However, the progress of additional deterioration with longer storage was slow, so that specific gravity reductions after 1 year ranged from 4 to 8 percent. Loss of water from peeled bolts was rapid for the first 2 months; thereafter, moisture content tended to fluctuate with weather conditions. Decay and reductions in specific gravity were greatest when abnormally wet weather prevailed during much of the storage period. They also were greater in bolts of large as compared to small diameters, but showed little variation in ends versus middle parts.

The fungus *Peniophora gigantea* was associated with most of the losses due to decay. Since this fungus attacks both cellulose and lignin, the percent losses in pulp yield from wood decayed by it would be expected to at least equal the percentage reduction in specific gravity of the wood.

Pulping trials by the U. S. Forest Products Laboratory on peeled and unpeeled bolts from an October-cut series that was stored for 4 to 12 months indicated that (a) chemical composition of the wood had not changed greatly during storage, (b) losses in pulp yield were largely represented by the percent decrease in specific gravity with increase in storage time, and (c) pulp strength properties were not reduced until after about 6 months of bolt storage and were evidenced by a slightly lower tearing strength and greatly reduced folding endurance. From correlation of these various studies, it appeared that pronounced changes in pulp quality or losses in yield exceeding 5 percent are unlikely until after 2 to 3 months of spring and summer storage or 4 to 6 months of fall and winter storage. For storage periods no longer than this, peeled wood is likely to show yield and quality losses at least as high as those for unpeeled wood; for longer periods, progressively greater losses would be expected in unpeeled wood.

In tests of chemical treatments that might prolong safe storage periods, the most effective were: For unpeeled wood, end sprays with 3 to 4 percent solutions of ammonium bifluoride or sodium fluoride, applied within a day or so after bolt cutting; for peeled bolts, full-length sprays or dips with the above solutions applied shortly after peeling. Such treatments greatly reduced decay in winter-cut unpeeled wood stored for 8 months and in both winter- and summer-cut peeled bolts stored for as long as 1 year.

The indications from some of these results are: (a) rapid seasoning is of no value in reducing deterioration in unpeeled wood; (b) time of year of cutting and storing unpeeled wood is important only for storage periods of 9 months or less; (c) for storage periods of 2 to 3 months in summer or 4 to 6 months in fall or winter, leaving the bark intact is preferable to removing it; and (d) practices that will reduce deterioration in unpeeled wood include those of maintaining high moisture conditions in the wood, favoring bolts of large diameter for storage, storing bolts of as long length as possible, and possibly using an end spray with a fluorine treatment. For peeled wood, the practices include those of hastening drying of bolts by improved air circulation, favoring small or split bolts for storage, and possibly spraying or dipping full length in a fluorine solution, provided it is applied shortly after peeling.

Pine sawfly

The sawfly, Neodiprion sp., which during 1946 and 1947 reached epidemic proportions in southern Arkansas, continued its decline in 1950. Defoliation was light and occupied a much smaller area than in the previous years. However, peculiar weather conditions resulted in an emergence of parasites following the peak activity of sawfly larvae. This occurrence suggests that an increase in sawfly population is possible for 1951. There is some evidence that areas from which the sawfly had completely disappeared are being reattacked. A new infestation in north-central Louisiana was located.

Oak leaf miner

The oak leaf miner (Baliosus ruber) did considerable damage by defoliation in 1946 and 1947 near Tallulah, Louisiana. Tests on control by aerial application of DDT were conducted in 1947, and though the tests were limited in scope it appeared that control was successful. In 1950, the Chicago Mill and Lumber Company at Tallulah reported that severe defoliation was occurring again and that many trees were dying. The company obtained the temporary services of a Canadian entomologist to analyze control of the insect through biological methods. Limited observations in the past indicate that biological control is now operating in this area, but it is very doubtful that the breeding and liberation of adult parasites will establish biological control at a high level. Also, the breeding of parasites in quantities sufficient for control is a very expensive and time-consuming effort. It is believed that the best method of control would be to supplement the biological control by the application of DDT. Mortality of the oaks is due indirectly to this insect. Severe ice and hail storms have contributed greatly to the deterioration of the timber stand.

Southern pine beetle

This insect, Dendroctonus frontalis, occupied the position of greatest importance during 1950. An outbreak, resulting from a slow build-up in the last several years, occurred in southeast Texas. The Texas Forest Service estimates that over 32 million board feet of pine was killed in 1950. Damage occurred over an area of about 200 square miles in patches usually of 1 to 2 acres, although a few were 25 to 100 acres in size. In view of the potential danger of a widespread epidemic involving the whole of east Texas and western Louisiana, immediate action was taken. The Division of Forest Insect Investigations has cooperated with the Texas Forest Service and timber operators in the effort to bring the outbreak under control. Promising results were obtained from insecticide sprays, particularly benzene hexachloride formulations. Experimental flights have been made for the testing of photographic techniques to be employed in survey of outbreaks, and demonstrations and instructions have been given on the most effective means of bringing infestations under control.

Turpentine beetle

The black turpentine beetle, *Dendroctonus terebrans*, continued for the second and possibly third year in an unusual killing of pine. Numerous reports of damage have been received from forestry organizations, timber operators, and the naval stores industry. The most severe commercial kill was observed in Louisiana, where about 1 million board feet of timber and an unknown quantity of pulpwood were salvaged from 30,000 acres following beetle attack. On the McNeill Experimental Forest of the Southern Forest Experiment Station, up to 6 dead trees per acre were tallied in 1949; it is estimated that a maximum of 10 trees per acre were killed in 1950.

It was not possible to conduct studies to learn why this insect is killing trees. However, it is believed that increase in beetle populations made possible by unseasonably warm winters in 1949 and 1950 plus low tree vigor brought about by spring and summer drouth and severe storms since the hurricane of 1947 resulted in mortality following beetle attack.

Results of limited studies indicate that new hydrocarbon insecticides offer considerable promise in control of the beetle in turpentine orchards. At present there appears no practical control of the insect in the forest except early removal of infested trees and destruction of the insect brood.

Ambrosia beetles

During 1950, emphasis was placed on testing the effectiveness of different formulations of benzene hexachloride applied by various types of equipment. All new treatments were tested against the standard recommended benzene hexachloride formulation of 0.5 percent gamma in No. 2 fuel oil applied at the rate of 1 gallon of solution per 100 square feet of bark area. This treatment remains the best in every respect. Included in the tests were wettable powders in water suspensions, dry dust applications, and concentrates applied in the form of mists and thermo fogs.

As a result of contacts with the wood industry operating in the tropics, two phases of log treatments which had previously received no attention were investigated. It was found that treatments with oil formulations cannot be made successfully when the bark of logs is wet, because of lack of penetration of the toxic into the bark. In addition, studies revealed that the smooth bark of some tree species does not take up enough of the standard oil spray to provide the usual period of protection (3 or 4 months or longer). On the basis of this finding, it will be necessary to develop formulations which may be retained by species having this type of bark. Use of heavy carriers or adhesives will be tested.

In the protection of lumber, superior results were obtained with a benzene hexachloride concentrate applied as a mist. Benzene hexachloride dusts show considerable promise in the protection of lumber, particularly when exposures are not unusually severe.

Benzene hexachloride was tested against a few other chemicals. Among these other chemicals was creosote,which has been given considerable publicity--particularly by the Australian wood industry--as being effective against ambrosia beetles. These tests reveal that creosote, whether straight or diluted, had no repellent effect on ambrosia beetles. In fact, attack seems more severe than in untreated logs.

Powder-post beetles

Studies on the Lyctus powder-post beetle are aimed particularly at preventing attack of seasoned and unseasoned hardwoods. It is yet too early to report the effectiveness of the various chemical treatments, most of which were applied as 3-minute dips. In dry wood treatments made in April 1948, only wettable sulphur, applied as a dip, and a chlordane plus DDT combination, applied as a mist, have failed. Tests on green wood treatments reveal that sulphur is failing. This chemical is one of the treatments heretofore recommended. The other failure in this group was 2 percent sodium pentachlorophenate. In the control of active infestations, it appears that almost any chemical, even a fuel oil carrier itself, will kill the insect within the wood.

A 2-year test on the effect of pentachlorophenol on metal was closed recently. Results showed that 5 percent pentachlorophenol in fuel oil does not cause paint to break down (with subsequent rusting of metal) any more rapidly than when tools are untreated.

Ips and borer control in pulpwood

Emphasis this year was placed on testing benzene hexachloride formulations, since this chemical proved superior to all others in 1949 tests. The development of an inexpensive formulation of the water emulsion type was given particular attention. Results to date are preliminary, but it appears that only the 0.25 percent gamma in oil is effective and practical from the standpoint of cost.

A large-scale test was conducted at a pulp mill with the aim of protecting the pulpwood from insect attack and thereby permitting longer storage of wood in the yard. Oil formulations and concentrates were applied by means of various types of spray equipment to entire truck loads prior to unloading and to stacked wood immediately after unloading. Examination after a 2-month exposure under intense beetle population revealed that the 0.5 percent gamma in oil was the only successful treatment. It is hoped that this treatment will give the results obtained in screening tests--that is, almost complete protection of pulpwood from insects and decay for about 6 months.

Preservation--fabrics, wood, and wood products

A large number of treatments were applied to cotton fabrics, ropes, and insulation materials to protect them from termite damage during temporary contact with the soil. After 160 days, only copper naphthenate, zinc naphthenate, and copper-8-quinolinolate were free of attack.

Construction panels made of kraft honeycomb containing various percentages of phenolic resins have been exposed to termite attack for over 2 years. Only the very low impregnations have been damaged. It is a question of whether the high impregnations would prove economically feasible.

In 1945, small dimension sap pine stakes were given 3-minute dips in a number of wood preservatives to determine the value of the preservatives in preventing termite attack. After 5 years' exposure, 2 percent copper naphthenate has given best results. Among the failures were 5 percent pentachlorophenol, 2 percent zinc naphthenate, and a combination of DDT plus 5 percent pentachlorophenol.

Subterranean termite control

A survey was made of Federal housing projects constructed during World War II. The object was to determine what types of construction are most effective in preventing termite attack and whether the preventive measures recommended by this Division were effective in reducing termite damage. Highlight of the survey was the fact that the slab type of construction, which is becoming increasingly common, was found to be most susceptible to termite attack. Infestations in such construction are very difficult and expensive to remedy. Monolithic floor slabs appear more effective against termite penetration, although there is a possibility that termites will enter through cracks. Tests are being planned for the development of expansion joint fillers superior to those now in use.

PLANS FOR 1951

FOREST MANAGEMENT

The present national emergency will certainly affect forest research. The loss of personnel to the armed forces plus the shift of manpower to problems directly connected with national defense will call for adjustment in the forest research program of the Southern Station in 1951. Some desirable new studies will have to be postponed and some studies now under way may have to be placed on a stand-by basis. At the same time, increase in the productiveness of our forests is of crucial importance to the future of our country, and research is very necessary to find the methods and means of securing such an increase. For this reason, every possible effort will be made to maintain those studies that are of major importance.

The text for a technical bulletin, "Planting the Southern Pines," will be multilithed for limited distribution and board-of-review action. A study plan will be prepared and circulated to enable public agencies and private groups to test geographic seed sources most suitable to their planting sites. Some pollen will be collected and a few artificial crosses of southern pines made as a start toward the study of improvement of tree quality and resistance to drought and disease.

Alexandria

Work on site preparation and other methods of stimulating early height growth of planted longleaf pine will continue. The original study of underplanting and release will be supplemented by further work with longleaf pine. Investigations into direct seeding of southern pines will be continued. The results to date will be reported. A report containing recommendations on the choice of species for planting sites in southwest Louisiana will be prepared. It will be based on findings of a plantation survey currently under way.

A report will be prepared covering a comprehensive longleaf pine plantation pruning study recently installed. A comprehensive study of thinning slash pine plantations will be planned, and installation started late in 1951. The object will be to determine the effect of 10 different thinning treatments on basal area increment.

Birmingham

Because of the increased demand for local information on the methods and cost of eliminating low-quality and cull hardwoods from managed stands, a test of three of the more promising methods will be undertaken during the year. These are: (1) poison in low cups, (2) frill, and (3) two-hack girdle. A study will be installed to test the use of controlled fire for the reduction of hardwood brush and the establishment of more favorable pine growing conditions.

A third and final series of plots designed to test the effects of various maximum tree sizes and stand densities upon growth per acre per year will be installed. One additional replication of the Flat Top Experimental Forest improvement cutting study will be installed, with two additional treatments prescribed by the Division of Forest Economics.

Brewton

A study covering methods and means of converting unmanaged longleaf pine forests to a managed condition will be initiated. Installation of the large-scale study on management systems and rotations for second-growth longleaf pine forests will be continued. Scrub hardwoods will be cut from areas that have not as yet had adequate treatment. Brownspot will be controlled by fire wherever this is necessary.

The study of the effect which longleaf pine seed trees and forest walls have upon the development of longleaf seedlings will be reexamined and brownspot control will be undertaken where necessary. The stage of development at which longleaf seedlings benefit most from control of overstory oaks will continue under study. Older plots in this study will be examined and results to date will be published.

A study of the effect of stocking of second-growth longleaf upon growth and quality production will be installed. Fifteen-year results from the Loxley longleaf thinning study will be published. The effect of first-year rainfall on the regeneration of longleaf pine on dry sites will be studied.

Central Ozarks

A reconnaissance will be made to discover what relation exists between parent soil material and occurrence of redcedar in the Boston Mountain Plateau. All material thus far obtained on the occurrence, growth, and yield of redcedar in the Ozark region of north Arkansas will then be summarized in bulletin form. A reproduction count will be made to compare survival of planted redcedar stock in openings created by cutting and in natural openings. A comparison will also be made of the differences in stocking between openings that were planted to redcedar and those that were left to regenerate naturally.

Field measurements will be made to determine the composition, production, and quality of native forage in sparse and poor hardwood stands. A work plan will be prepared for a study of the intensity of timber stand improvement work that is profitable in cull hardwood stands. Field measurements will be obtained on the oak crop tree study.

Crossett

Installation of the large-scale methods-of-management study will be continued during the year. Six compartments, two each of the short-rotation single-tree selection system, the group selection system, and the seed-tree system, will be cut. Information on logging costs, log size, and log grade will be obtained. All compartments will be given timber stand improvement.

Reexamination of the study on the effect of moisture, light, and nutrients upon the survival and growth of pine seedlings will be made. Methods of increasing pine seed production by girdling and banding seed trees will continue to be studied.

Work will be continued on installation of a study on the direct seeding of loblolly pine on sites devoid of an adequate pine seed source. Burning and disking will be tried, and stratified and unstratified seed will be sown on three different dates.

To determine whether the invasion of sweetgum into pine stands can be halted through elimination of the seed source, it must first be ascertained how far this wind-borne seed is carried. A test of this will be undertaken during the year.

The study on the various methods and means of eliminating low-grade hardwoods from pine stands will be reexamined during the year.

Installation of the 2-year season-of-girdling study will be continued throughout the year. Hardwoods are being girdled every month throughout the dormant season and twice each month during the growing season over a 2-year span to determine at what season girdling gives the best crown kill and the least sprouting. Plots on which hardwoods were girdled last season will be reinventoried during 1951.

A study on the effect of understory hardwoods upon the growth and development of the overstory pine stand will be installed.

A study will be undertaken to determine whether hardwoods will reinvade pine stands after cleaning. A study of how and when to prune shortleaf-loblolly pine plantations and the effect of various crop tree spacings upon the early production of large-size, good-quality sawlogs will be started.

It is planned to begin an experiment in which dominant trees only will be left in one area, codominants will be left in another, intermediate trees in another, and suppressed trees in another portion of a 15-year-old even-aged stand. Trees of all classes will be allowed to recover from suppression and then measured for diameter, height growth, grade, and length of clear bole to determine whether codominant, intermediate, and suppressed trees are genetically inferior to dominants or whether they are merely victims of environment.

Delta

A new exploratory study on the possibilities of developing superior strains of cottonwood through vegetative propagation will be undertaken during the year. Arrangements have also been made to test four promising cottonwood hybrids from Holland for adaptation to Delta planting sites.

A new bulletin giving results of all cottonwood research work at the Delta Station will be submitted for publication in 1951.

All pilot-plant cottonwood cultivation tests installed on abandoned agricultural land in the Delta in the last 2 years will be remeasured. A new self-propelled rotary tiller for preparation of planting strips on tough planting sites will be tried. Korean lespedeza will be used in a small exploratory test as a ground cover to keep down weeds under cottonwood plantings in natural openings.

Fifty seedlings of the dawn redwood (*Metasequoia glyptostroboides*) will be planted to determine if it can be made to grow on the moist sites adjacent to cypress swamps in the Delta.

Work on the three intensity-of-improvement-cutting studies will be continued, and articles giving results to date will be prepared. The effect of stand condition upon bottomland hardwood reproduction will be investigated in an attempt to correlate site, drainage, soil conditions, and overstory with the amount and kind of hardwood reproduction. All stand data collected on the Delta Experimental Forest and elsewhere will be analyzed in order to aid in setting up silvicultural practices for individual species.

East Texas

Further observations and analysis of the results obtained to date on the use of Ammate for the killing of undesirable hardwoods will be made.

The establishment report for the large-scale systems-of-management study will be completed. Three hundred and seventy-five acres of the study area will be given a first or second controlled burn, and control of the Texas leaf-cutting ant will be undertaken. Additional plots on the study comparing growth and returns from all-aged stands managed under the D + 6 and the single-tree systems of selective timber management will be installed. Timber stand improvement will be undertaken on all plots established to date.

Work on the bottomland hardwood method-of-management study will continue. Undesirable trees will be girdled on the intensive treatment plots.

Project analysis of the study on the use of controlled fire in the management of upland pine-hardwood stands will be completed, and plans for additional studies made. Three hundred and twenty acres of the Sam Houston brush and hardwood control study in the Big Thicket area will be reburned in the spring; 480 acres will be given an **initial** burn in the summer; and 320 acres will be reburned in the winter. Three blocks will be inventoried at the end of the 1951 growing season.

Gulfcoast

Reinventory, marking, and thinning of three intensive treatment study compartments of the McNeill Experimental Forest commercial stand management study will be completed. Plans for obtaining growth and mortality data from sample plots will be prepared. Rehabilitation of bottomland hardwood areas will continue. A manuscript will be prepared on the effect of release on growth of residual longleaf trees.

Results of the study of fire resistance of longleaf pine seedlings of various ages will be published. A manuscript on the relationship between amount of scorch from fire and mortality will be written. A major publication dealing with the over-all effects of controlled and uncontrolled fire on the management of the longleaf-slash pine type will also be attempted.

The third field planting and second remeasurement of the longleaf pine seed-source study will be made. Work on fertilization and seed production from longleaf seed trees, effects of fire on site preparation, and stimulation of height growth by burning and fertilization will continue, as will field studies of physiological grades and seedling nutrition.

Tallahatchie

Study of the comparison of important characteristics of the seven principal soils of north-central Mississippi and western Tennessee will continue, and a study of humus types will be initiated.

Loblolly pine and hardwood underplantings released by girdling or poisoning will be reexamined and treated where necessary.

Survival, growth, and vigor of the planted cottonwood seedlings will be recorded. Survival and growth of the hybrid pine plantings will be tallied at the end of the growing season. Work on the loblolly pine seed-source study will continue.

Farm Forestry Research

Alabama

Because of the resignation of the project forester, future work in the Alabama cooperative farm forestry research project is uncertain.

Mississippi

Cooperative cottonwood planting near State College will be reexamined at the end of the growing season. The study of costs and returns from farm plantings of Christmas trees in central and northern Mississippi will be installed during the spring. Assistance on farm forest management practices will be given the Coastal Branch of the Mississippi State Agricultural Experiment Station at Newton, Mississippi. Hybrid pine test plantings will be reexamined.

FOREST ECONOMICS

Forest Resources

Timber resources of Tennessee and Arkansas.--A State statistical report on forest acreage, timber volume, growth, and drain in Tennessee will be published as a Forest Survey Release in 1951. An earlier release on acreage and volume in eastern Tennessee will also be published.

The current Forest Survey inventory in Arkansas will be completed in April. A statistical report on forest acreage and timber volume in the Delta regions will be published. This will be followed late in 1951 or early in 1952 by a statistical report of all findings for the whole State.

In addition to the regular Forest Survey inventories, supplemental studies in both Tennessee and Arkansas will lead to comprehensive reports on the forest situation in these States. The comprehensive reports, which will be prepared after 1951, will summarize data about the forest and explain the situation in terms of forest-products industries, forest landownership, and other factors bearing on forest conditions.

Timber resources of Alabama.--Field work on the Forest Survey of Alabama is scheduled to begin in April, after work has been finished in Arkansas.

Characteristics of east Texas small-woodland ownership.--The East Texas Branch will study small-woodland management in Nacogdoches County. The analysis will include a few representative properties on which profitable forest management is being practiced, and also a few where poor management is being practiced. The object will be to evaluate the need for further research at the branch on the management of small forest holdings.

Forest Industry

Forest industries and timber drain in Arkansas and Tennessee.--Compilation of forest industry and drain data collected in Arkansas and Tennessee in 1949 and 1950 will be completed and the results published.

Pulpwood production in the South.--Annual pulpwood-production statistics for the South, by State and county, will again be obtained in cooperation with the Southeastern Forest Experiment Station and the Southern Pulpwood Conservation Association. This year's report, on 1950 production, will be published at the Southern Station.

Logging methods, equipment, and costs.--Analysis by the Birmingham Branch of costs of various methods of producing mine props and timbers will be completed and published. The Crossett Branch will study the methods and costs of producing pine pulpwood. Present costs will be compared with costs in 1940 and 1945. Results will be published as an Occasional Paper, thus continuing a series on this subject.

The tentative classification of inferior upland hardwoods based on 4/4 standard lumber recovery will be tested at several hardwood mills by the East Texas Branch in cooperation with the Texas Forest Service. Factory lumber logs of grade 3 and other low-quality logs will be sawed, a lumber-grade tally obtained, and log values determined. The next step will be to calculate comparable values for low-quality logs when cut for ties, timbers, and other items for which they are suitable. The objective will be to find out what use or combination of uses results in the maximum recovery value for each log or class of logs.

The Crossett Branch will study lumber grade yield from upland hardwoods. The growth rate and grade yield necessary for hardwood to compete economically with pine will be determined.

The Birmingham Branch will develop a system of tree classes and grades to reflect the utility of trees for various purposes. Through the Forest Survey, the quantities of the various classes and grades of standing timber in the Birmingham region will be secured. This information will later be correlated with information on the requirements of wood users for the various sorts of trees. Thus the Branch will have a basis for evaluating the forest resource in terms of its utility, and for determining the direction that should be taken by wood utilization changes on the one hand and timber stand improvements on the other.

Timber Marketing and Prices

Marketing problems in northeast Mississippi.--Small-woodland owners often find it difficult to market their timber products efficiently and profitably. Likewise, in areas where small, scattered forest owners predominate, wood-using plants and other timber buyers are handicapped in getting the raw materials they need. Such problems are of special importance in times of national emergency.

The Southern Station will cooperate with the Mississippi Agricultural Experiment Station in a study of the timber marketing problems of northeast Mississippi--an area typified by small, scattered forest tracts and small-scale wood-using operations. As a basis for recommending improved marketing procedures, or additional research on particular problems, an effort will be made to define the major problems of a representative 17-county district. During 1951, a working plan for this analysis will be completed, a field survey will be made, and results will be analyzed.

Timber markets and wood products specifications in the Central Ozarks.--The Central Ozarks Branch will make a survey of markets available to forest owners in its territory and will study the specifications for wood taken by these markets. The aim is to learn the utilization and marketing problems upon which research may be based at the Branch.

Economics of Forest Management

Guides to profitable forest management.--In cooperation with the Southern Kraft Division of the International Paper Company, a study of financial aspects of all-aged versus even-aged management will be continued. The returns from clear-cutting in strips on two forties near Canton, Mississippi, will be compiled into an office report.

A study will be made in the Birmingham area to help forest owners decide when upland hardwoods have reached financial maturity for various products. The results should show the comparative financial advantages of cutting trees for different products, and should serve as a guide in making improvement cuts. Marking rules will be set up after the data have been analyzed.

During 1951, an outline and plans will be made for a bulletin reporting results under the "Guides to profitable forest management" project.

Returns from well-managed commercial forests.--Another year's costs and returns from the selectively managed 1,000 acres of shortleaf-loblolly pine-hardwoods at the Crossett Branch will be reported. A report covering 10 years of management on this area will be prepared for publication.

At the Brewton Branch, another cut will be made on the 640 acres of intensively managed second-growth longleaf pine, and the 3 years of management and harvesting will be analyzed and reported.

At the Central Ozarks Branch, 2,500 acres of upland hardwoods and shortleaf pine on the Sylamore Experimental Forest will be set up as a research model of a commercial forest. An improvement cutting will be made and an inventory taken of growing stock.

Returns from well-managed small tracts.--Studies of the financial possibilities of small woodlands will be continued at eight branch stations during 1951. Methods of managing and harvesting timber will be demonstrated, and records of costs and returns will be released. Field days for farmers will be held at most branches to show what products can be harvested and how profitable farm forestry can be.

Special Studies for National Defense

As a part of national preparedness and defense measures, the National Security Resources Board and the National Production Authority have asked the Forest Service to make a nation-wide survey of requirements for labor, equipment, and supplies in logging. The Station will handle the part of this survey that falls within its territory. Some 150 wood users and the loggers who supply them will be canvassed. It is expected that the survey will be completed during the first half of 1951.

RANGE RESEARCH

Alexandria

Grazing management.--Five manuscripts on Alexandria grazing management studies have been prepared. Three of these, including a proposed Louisiana Agricultural Experiment Station bulletin on range forage grazing values, have been submitted for publication. The other two, one on important forage plants, and one on seasonal herbage production, require further work in 1951. No additional field work is scheduled until 1953 on the study of herbage changes following hardwood control.

A major forage management study will be initiated in 1951. Efforts are being made to get fences constructed on the Longleaf Tract for a controlled grazing management study. The study plan, "Yearlong vs. seasonal grazing of forest range," has been prepared, but is subject to modification. Alternate new studies are being considered in case the fences and other facilities are not available for the proposed major study.

A study will be initiated early in 1951 to test hog damage to longleaf and slash pine under controlled conditions; to test the possibilities of repelling hogs by electric fence; and to test the effectiveness of three chemical repellents. Grazing damage surveys on planted slash pine will be continued to determine the residual effects of 1949 grazing.

Control of undesirable hardwoods.--The four tree poisons or combinations found most effective in 1950 will be tested in frills, on stumps, and as trunk sprays during four seasons in 1951. At least two concentrations of each chemical will be tried--either 1, 2, 3, or 4 percent, depending on cost and effectiveness.

Artificial revegetation.--The study in establishing and grazing firebreaks will be continued for several more years. Some new plantings will be established in cooperation with the Industrial Lumber Company, Elizabeth, Louisiana. Several of the species that failed in the range nursery test during 1950 will be tested again in 1951. Other species recommended by qualified research agencies will be planted in 1951. Periodic examinations will be made to find species best suited for planting on forest ranges and on grazed firebreaks.

Brewton

An article is planned on the first 3 years' results on the ecological phases of the study on forage production as related to tree stands. Field records will be continued on this study as well as on the study of poisonous plants and that of grazed firebreaks.

Central Ozarks

Field measurements will continue on the study of forage production in upland hardwoods. Remeasurement of permanent deer-forage plots missed in 1950 will be made in 1951.

Gulfcoast

Results of the first season of grazing steers on short and long season forest range pastures at McNeill will be prepared for publication. The study is to be continued in 1951 with an increased number of animals.

FOREST UTILIZATION SERVICE

A number of projects will carry over in 1951. The sawmill waste study data are being worked up on a cubic-foot basis to establish complete and reliable converting factors. A paper covering all phases of this study is being prepared for the annual meeting of the Forest Products Research Society. Sidelights, including the weights of logs by diameter and log scale and accurate overrun figures, will be published in trade journals.

The bulletin, "Fence Post Barking Machines in the South," will be revised to include several newly developed machines.

The log grade-grade yield recovery study will be broadened to include recommended practices for improving the quality of lumber output and for increasing the financial return of the many small mills cutting upland hardwoods. The low-grade hardwood utilization study in east Texas will be continued with the object of finding ways to utilize the low-grade trees for the highest value products that can be made. Marketing data for the various products will be needed to complete this study.

The cooperative study with the Forest Products Laboratory and the Tennessee Valley Authority will continue the investigation of wood molasses as a food for livestock.

Instruction in hardwood log grading will continue to be given. Preliminary arrangements have been made for schools in east Texas and north Louisiana.

In cooperation with the U. S. Forest Products Laboratory, a study will be made of the factors affecting the specific gravity of southern pine.

The wood pallet industry in the South will be analyzed to determine the possibility of increased use of low-grade hardwoods.

FLOOD CONTROL SURVEYS

Survey plans for the year ahead are geared to completing all projects in the Arkansas, White, and Red River watersheds so as to contribute to the Inter-Agency Committee's comprehensive resource development plan for this basin. This will involve formulation of flood control recommendations and evaluation of program costs and benefits for the Ouachita and White River basins, and similar information for forestry phases of the surveys in the Upper Arkansas and Lower Red River basins.

Also scheduled for completion are forestry contributions to Soil Conservation Service surveys in the Savannah, Apalachicola, and Trinity-San Jacinto watersheds. A new survey will be initiated for the Hatchie River watershed (Tennessee).

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No. 66. March 1950.
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Cottonwoods respond to selection cuts. J. W. Johnson.
Size of pine logs cut in Arkansas, Louisiana mills. R. D. Carpenter.
It isn't the ashes. David Bruce.

No. 67. May 1950.
Good growth from well-stocked longleaf stands. L. F. Smith.
Accuracy of ring counts on increment cores. J. L. Burkle.
Quick returns from releasing pine. W. F. Mann, Jr.
Pine growth doubled by improvement cutting. Frank Freese, Jr.

No. 68. July 1950.
Second forest survey of southwest Arkansas. Wm. A. Duerr.
BHC protects logs and lumber from pin hole borers. R. J. Kowal.
Mortality following thinning. H. L. Williston.
Wood density influences pulp yields. M. M. Lehrbas.

No. 69. Sept. 1950.
Commercial improvement cut in bottomland hardwoods. J. W. Johnson.
Cultivating boosts fusiform rust infection. D. L. Westberg.
Competition for light, water, and nutrients. W. F. Mann, Jr.
Scrub oak helps longleaf seedlings on deep sand. E. M. Gaines.

No. 70. Nov. 1950.
Oak wilt in Arkansas. T. W. Bretz and B. W. Henry.
Cord mortality in unthinned pine stands. Henry Bull.
Variations in diameter-tape measurements. J. J. Brasington.
Direct seeding gives good results. H. H. Muntz.
Douglas-fir shipments to the South. M. M. Lehrbas.

No. 71. Jan. 1951.
Clipping and dipping reduce longleaf mortality. R. M. Allen.
Costs of cutting mine props from pine and hardwoods. R. M. Osborn.
Planted hardwoods survive and grow rapidly. B. J. Huckenpahler.
Redcedar litter improves surface soil. W. M. Broadfoot.
Height growth of pine seedlings. H. L. Williston.

TECHNICAL PERSONNEL

SOUTHERN FOREST EXPERIMENT STATION

1950

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Ralph A. Read	Harrison, Ark.
Eugene Shoulders	Harrison, Ark.

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Charles X. Grano	Crossett, Ark.
William F. Mann, Jr.	Crossett, Ark.
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Louis C. Maisenhelder	Stoneville, Miss.
Joseph S. McKnight	Stoneville, Miss.
J. William Johnson	Stoneville, Miss.

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Stuart F. Clark	Nacogdoches, Texas
Edward B. Williams	Nacogdoches, Texas
George M. Judson	Nacogdoches, Texas
Edwin A. Hebb	Nacogdoches, Texas
Arnold L. Mignery	Nacogdoches, Texas

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Lloyd F. Smith	Gulfport, Miss.
David Bruce	Gulfport, Miss.
Robert M. Allen	Gulfport, Miss.
Edwin R. Ferguson	Gulfport, Miss.

Tallahatchie Branch

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Bernard J. Huckenpahler	Oxford, Miss.
Walter M. Broadfoot	Oxford, Miss.

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Arthur F. Verrall	Gulfport, Miss.
Paul V. Siggers	Saucier, Miss.
Berch W. Henry	Gulfport, Miss.
George M. Harvey	Gulfport, Miss.

Bureau of Entomology and Plant Quarantine

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John F. Coyne	Gulfport, Miss.
Harmon R. Johnston	Gulfport, Miss.
Robert C. Morris	Gulfport, Miss.
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THIRTY-FIRST ANNUAL REPORT, 1951

SOUTHERN FOREST EXPERIMENT STATION
Harold L. Mitchell, Director
New Orleans, La.
FOREST SERVICE, U.S. DEPT. OF AGRICULTURE

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THIRTY-FIRST ANNUAL REPORT, 1951

The Southern Forest Experiment Station issued more technical publications in 1951 than in any previous year. All add to knowledge of southern forestry, and some are major contributions that are likely to become the working manuals of most southern foresters and timber landowners for many years to come.

The entire field of pine planting, from seed collection to the management of young plantations, is covered in P. C. Wakeley's encyclopedic "Planting the Southern Pines." In "Management of Bottomland Hardwoods," J. A. Putnam has given foresters their first comprehensive guide to the management of this important forest type. A complementary paper advises forest managers on determining financial maturity in bottomland species. A new bulletin by L. C. Maisenhelder provides the technical basis for the successful establishment of cottonwood plantations on thousands of lowland areas unsuited to other crops.

W. E. Bond and R. S. Campbell show how a program of timber growing and forest range grazing can restore to full production 1½ million acres of cutover longleaf pine land in southwestern Louisiana. In "Woods Hogs Vs. Pine Logs," Walt Hopkins presents convincing proof of the damage done to longleaf pine by free-ranging piney woods rooters.

Other Station publications in 1951 evaluated planting sites in north Mississippi, described treatments that restored the ailing Ashe Nursery to full production, determined the South's annual income from timber products, analyzed the results of one of the oldest longleaf pine thinning studies, advised farmers how to manage shortleaf-loblolly pine woodlots for maximum returns, and reported on the cost of cutting mine props in Alabama and pulpwood in Arkansas.

Forest Survey published a comprehensive report on "Mississippi's Forest Resources and Industries." It also mapped lumber production in the central South, appraised cutting practices in Arkansas, completed the timber inventory in eastern Tennessee, and compiled statistics on the biggest pulpwood harvest the South has ever seen.

The year's publication record is largely the culmination of the expanded research program provided for by Congress at the close of World War II. Whether this record of production can be maintained in the face of inflation and the gradual attrition resulting from reduced appropriations and increased responsibilities in recent years seems doubtful at the present time.

To meet the latest monetary and personnel ceilings voted by Congress, it was necessary to eliminate an average of one technical man at each Branch during the year, and to make equivalent reductions Station-wide. The Station's total manpower on regular projects is now down to about 70 percent of what it was during the peak years following the war. Naturally, some desirable work has had to be dropped.

The readjustment was made the more difficult by the greatest turnover of technical personnel in the Station's history. During the year promotions, transfers, resignations, and losses to the armed forces resulted in over 25 vacancies, including the Director, two Division Chiefs, and four Research Center Leaders.

The needs of national defense imposed large burdens on the Station, and seem likely to continue doing so. In 1951, the Station made timber resource analyses in connection with 27 applications for accelerated tax amortization. It also participated in a national survey, conducted for the National Production Authority, to determine the equipment, supplies, and manpower requirements of the forest products industries. The Station's Forest Utilization Service cooperated with the armed services on a number of special studies.

Late in the year responsibility for the Vicksburg Infiltration Project was transferred from Washington to the Station. This, too, is a defense activity. It is financed by and carried on in cooperation with the Corps of Engineers at the Waterways Experiment Station, Vicksburg, Mississippi. Information on the project is restricted, but it is anticipated that certain accumulated data on soil-water-cover relationships will eventually be released for publication.

The Station participated fully in two special analyses of forest and range resource management problems and research needs: the Arkansas-White-Red River Basin Plan (AWR) and the Nation-wide Cooperative Research Reappraisal.

The AWR activities were along three main lines. First was the preparation, for the AWR Basin Inter-Agency Committee, of a report on the present forest and range research program, forest land problems, and the needed expansion of research. The second activity involved Station representation on numerous State committees and working teams charged with preparing correlated reports of resource management needs and programs for the individual States in the Basin. Finally, the Station continued to conduct flood control surveys fitted to the needs of the AWR Basin Committee.

The Nation-wide research reappraisal was undertaken when Congress requested the Forest Service to explore ways of meeting the vastly increased public demand for research needed to improve the management of the country's currently depleted timber and forage resources. The House Appropriations Committee, in its report on Forest Service appropriations, emphasized the desirability of strengthening forest research facilities, "despite the impossibility of providing additional Federal funds," and proposed financing the needed expansion with cooperative funds from "local sources." A Forest Service report on opportunities for such cooperation was duly submitted to Congress. Copies of the report are available in limited number.

The report showed that, for the Nation as a whole, annual non-Federal expenditures (excluding capital investment) for forest and range management research jumped fivefold from 1940 to 1952, and now exceed Federal appropriations by 18 percent. The advantages of cooperation also seem to be widely recognized, since about half of all non-Federal forest research funds are now for studies carried on in cooperation with the U. S. Forest Service. State and private groups over the Nation expressed a willingness to contribute over $100,000 of new money for cooperative research within the year. An additional $300,000 is available contingent upon approximately $500,000 of new Federal outlays.

The survey found it generally true that present and potential cooperation is less readily available in States where the need for forest research is the greatest. Southern non-Federal expenditures for forest and range management research still lag far below the national average--only 83 cents per Federal dollar, as compared with $1.34 and $1.32 for the North and West, respectively. Moreover, since 1949 Federal funds available for research in the South have decreased significantly, all activities considered, so that the total (Federal, State, private) is currently far short of minimum requirements. A mandatory dollar-for-dollar matching requirement, without new Federal money, would tend to siphon present Federal funds from going research in the South to new cooperative projects in other States better able or more willing to match the Federal appropriations.

The report also showed that there is little non-Federal money available for urgently needed basic research in such long-neglected fields as use of fire, genetics, soils, silvics, and forest influences. Such research would be largely neglected in an expanded program financed entirely from cooperative funds, and so will probably remain chiefly a public responsibility.

During the year the Station made substantial progress in developing additional cooperation with the States and industry. The Florida Legislature appropriated $20,000 per year for the biennium to match or supplement Federal funds for forest and range research in the scrub oak sand hills of western Florida. Two industrial landowners joined in providing an experimental forest in the area.

The Corps of Engineers provided additional funds to speed up cooperative studies on soil-water-cover relationships.

Near the end of the year, one lumber company promised to help finance cooperative research in forest genetics, and several other lumber companies indicated an interest in starting a forest soils project. Officials in two States planned to present to their Legislatures formal requests for funds to strengthen going research programs in their States. Fifty-two cooperators joined with the Station in starting a South-wide geographic seed-source study.

All these are new cooperative ventures, and do not include existing cooperative arrangements with all State experiment stations in our territory, most State forest services, various trade and forestry associations, and many industrial concerns.

RESULTS

FOREST MANAGEMENT
(including Forest Influences)

Regeneration

The Station's biggest single contribution to forest regeneration in 1951 was the publication (in preliminary form) of Occasional Paper 122, entitled "Planting the southern pines." This 3-volume paper, which summarizes the results of more than 25 years of study, covers pine planting policies, seed, nursery practice, planting, plantation care, and literature. A final printed version will probably be available in another year or so. A brief publication (Occasional Paper 123), "Storing southern pine seed," was also issued this year. It will be useful to all who are interested in avoiding loss from improper storage or handling of pine seed.

Another major contribution in the field of regeneration in 1951 was the completion, by the Delta Branch, of a bulletin entitled "Planting and growing cottonwood on bottomlands." The manuscript, which has been published as bulletin 485 of the Mississippi Agricultural Experiment Station, supersedes an earlier bulletin on the subject. It summarizes previous knowledge and records what the Delta Branch has learned in the last decade about propagation of cottonwood by cuttings or seed. Some of the newest and most important findings concern methods of site preparation and later cultivation.

Four years of cooperative research by the Southern Forest Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering on root-rot control and soil improvement at the Ashe Forest Nursery in Mississippi have been summarized in Occasional Paper 119. As a result of the investigations described, this large pine tree nursery is again in production. Soil fumigation with ethylene dibromide effectively controlled the rot, and the use of sawdust plus minerals not only improved nutrition of seedlings but reduced incidence of root rot.

A study of planting sites in north Mississippi and west Tennessee was completed. Occasional Paper 120 describes the different sites, appropriate species for each, and likelihood of success.

Nursery practice

Longleaf seedbed density.--Studies at the Harrison Experimental Forest nursery in south Mississippi during the past year show how the density of seedlings in the nursery seedbed affects the size, weight, and survival of longleaf pine nursery stock. Low-density beds produced seedlings with a root collar 0.4 inch in diameter, while seedlings in high-density beds had root collars 0.3 inch in diameter. Weight at lifting time and field survival records for seedlings from seedbeds of varying densities are shown in table 1.

Table 1.--Weight and survival of longleaf nursery stock

Number of longleaf per square foot	Weight of average seedling at lifting time	Survival after 4 months in field
	Grams	Percent
12	29	87
22	20	86
33	15	68
42	11	75

In this small test, the best nursery bed density appeared to be 22 seedlings per square foot. This density gave a satisfactory balance between nursery production per square foot and large, vigorous planting stock that survived well in the field.

Longleaf foliage treatment.--Clipping the foliage of longleaf seedlings before field planting continues to show promise as a means of improving field survival. This was shown in a test in which seedlings in the nursery bed had their foliage cut back to 4 inches at various times before planting on a fairly drouthy site in south Mississippi (table 2).

The usual effect of clipping in improving early field survival was shown by the examination made 4 months after the seedlings were planted. Clipping also improved 12-month survival, possibly by improving early growth and thus enabling the seedlings to withstand a late-season drouth. For the first 4 months after planting there was little difference in the survival of any of the groups of clipped seedlings. At 12 months, however, survival was best among seedlings clipped at lifting time or one month before.

Table 2.--Effect of foliage clipping on the field survival of planted longleaf pine seedlings

Date of clipping	Survival	
	4 months after planting	12 months after planting
	Percent	Percent
3 months before lifting	95	67
2 months before lifting	95	67
1 month before lifting	97	80
At time of lifting	98	79
Not clipped	74	38

Probably clipping should be done at the time the seedlings are lifted from the nursery beds. It is believed that the relatively good performance (table 2) of the seedlings clipped a month before lifting may be attributed to the cold weather that followed this treatment. This cold probably reduced photosynthesis of all seedlings so that loss of two-thirds of the foliage for a month did not make much difference, comparatively speaking.

Longleaf growth regulators.--Soaking the roots of 1-0 longleaf nursery stock for 18 hours in various concentrations of a growth regulator (indolebutyric acid) had little effect on first-year survival or growth in south Mississippi. Concentrations ranged from 2.5 milligrams to 160 milligrams of acid per liter of water. The highest, 160 milligrams per liter, appears to have reduced survival and may be in the toxic range. In all lower concentrations the main effect of soaking was to increase the number of new roots on the last inch of the taproot. Each higher concentration appeared to produce more new roots, with the number ranging from 1.5 new roots on untreated seedlings to 4.3 for the 160-milligram concentration of indolebutyric acid.

Right now, root-soaking of longleaf nursery stock to stimulate rooting does not seem to be a practical means of increasing survival and growth in the field after planting.

Cottonwood nurseries.--The cottonwood cutting nursery at the Delta Branch Station at Stoneville, Mississippi, produced its fifth crop of cuttings early in 1951. Rows in which the rootstocks were spaced 12 inches apart continued to give the best results. The nursery produced 20,000 cuttings per acre in 1947; 25,000 in 1948 and again in 1949; 32,000 in 1950; and 18,000 in 1951--a total of 120,000 in 5 years.

Production in 1951 was reduced because many of the sprouts from the 5-year-old rootstocks were too large to be utilized. General observation indicates, however, that survival of planted cuttings is not changing materially. Five years appears to be the useful life of a cottonwood cutting nursery.

A new cutting nursery of 1.5 acres was planted in March 1951. Rootstocks were spaced 12 inches apart in rows 40 inches apart. An extreme drouth, and a possible nitrogen deficiency in the heavy clay (buckshot) soil, prevented the nursery from yielding cuttings the first year.

The W. S. Barry cottonwood nursery, which was set out near Greenwood, Mississippi, in 1950, did not become well enough established to produce cuttings the first year, so failed areas are being replanted.

Direct seeding

Longleaf pine.--In south Mississippi, longleaf seed sowed 3 years ago on plots where burning logs had killed grass roots has produced seedlings which now average almost an inch in diameter at the ground line and over 4½ inches in height (i.e., ready to start height growth). The seedlings were kept free of brown spot by periodic spraying with a fungicide, but the increased growth apparently is attributable to the fact that hot fires from the logs freed the seedlings from competition with the grass. Seed sowed 3 years ago on plots previously burned by ordinary grass fires has produced seedlings less than ½ inch in ground-line diameter, despite the application of wood ashes at the time of sowing and periodic spraying for brown spot thereafter. Unsprayed seedlings have been severely defoliated by brown spot for the second successive year and have grown scarcely at all. Sprayed seedlings that had to compete with the grass made about half of their diameter growth in spring and summer, while sprayed competition-free seedlings achieved about 70 percent of their diameter growth in this period.

It appears that the most difficult portion of the longleaf regeneration problem might be solved by cheap measures for reducing grass competition and brown-spot infection.

Near Alexandria, Louisiana, large-scale tests of direct seeding with fresh longleaf pine seed were recently made on the Kisatchie National Forest and the Palustris Experimental Forest. Over 500 acres were seeded by airplane on November 28, 1951, and 100 acres were hand-seeded a week later. The seeding was on four separate areas, of which 350 acres were freshly burned, and 258 acres had a light or one-year rough. About 10 acres were thoroughly disked.

Preliminary results of these tests are:

1. Hand seeding with a common type of grass seeder gave good seed distribution at the rate of 3 or more acres per man-hour.

2. Fresh seed germinated promptly. By December 15 most of the seed had hypocotyls firmly established in mineral soil. Weather was favorable; 8 inches of rain fell in 16 days. Some seed washed into drifts on a 200-acre, clear-cut, burned site.

3. A 50-acre burn within a large open area was especially attractive to migratory blackbirds. Birds started feeding on this area immediately after seeding and removed practically all seed within 3 weeks, despite a bird patrol.

4. Fresh burns in areas surrounded by pine stands did not attract large flocks of migratory birds. However, a large proportion of the pine seed was eaten by small groups of local birds.

Meadowlarks were the principal seed-eaters, followed in order by blackbirds, robins, and quail. Doves were not observed.

5. Bird damage was heavy even in the light one-year rough. Native meadowlarks were chiefly responsible.

6. Rodent damage on all areas has been negligible. Some damage to germinating seed, not completely identified, was caused probably by harvest ants or small millipedes.

A 10-acre block on the old nursery site at the Alexander State Forest was seeded again in December 1951 with fresh loblolly seed. The seed used in 1950 was of very poor quality.

Loblolly pine.--At Crossett, Arkansas, direct seeding tests of loblolly pine have been confined to areas dominated by inferior hardwoods with little or no pine seed source. Such areas are prevalent and expensive to plant. Treatments attempted include seedbed preparation by either burning or disking; sowing in November, December, and March; and stratifying the seed before sowing. One pound, or about 21,000 seeds, has been sowed per acre. Hardwoods were girdled immediately after spring sowing.

Nearly all of the 15 treatments yielded better than 1,000 seedlings per acre. Only disked plots sown in November and December now have less than 700 trees per acre. On these, seed was broadcast on freshly plowed soil, where rains probably covered it with excessive loose dirt. The most successful treatment was November sowing of untreated seed on fresh burns: about 3,900 well-distributed seedlings survived per acre. This success is attributed to the exposure of mineral soil by burning, and to subsequent leaf-fall that concealed the seed from birds.

Ninety-day cold stratification of loblolly pine seed, and 30-day stratification coupled with holding the seed in a warm and humid environment until germination first starts, promise to give acceptable field germination in 15 days rather than in the 5 to 8 weeks usually required for untreated seed. The ordinary overwinter exposure of loblolly seed on the ground before germination increases the chance for seed losses to birds and rodents.

In general, disked plots had the greatest mortality, probably because the ridges thrown up by the disk were so high that they dried out too quickly. Height of the tallest seedlings for all treatments averages about 0.6 foot. Good survival and growth were probably due to the sparsity of grass on the forest floor--an effect of the dense hardwood overstory. For this and other reasons, elimination of these hardwoods must be closely timed with direct seeding.

Indications are that most of the pine seedlings will stay ahead of all competition, since less than 3 percent of them are now overtopped by hardwood sprouts, brush, and vines.

Underplanting

North Mississippi.--On the Tallahatchie Experimental Forest, the results of three years of underplanting low-grade upland hardwoods with six conifers strongly indicate the need for release when underplanting. Height growth of released conifers greatly exceeded that of unreleased trees (table 3). After two growing seasons, the released seedlings averaged almost twice the height of those unreleased. After three seasons, height differences were even greater.

Table 3.--Average height growth of conifers planted under low-grade hardwoods in north Mississippi

Species	Number of growing seasons			
	Two[1]		Three[2]	
	Released	Unreleased	Released	Unreleased
	Inches			
Loblolly pine	31	16	56	26
Shortleaf pine	21	10	31	14
Virginia pine	32	17	52	28
Slash pine	26	14	46	20
Longleaf pine	1	0	2	0
Eastern redcedar	14	7	18	9

1/ Average of 1949 and 1950 plantings.
2/ Includes only the 1949 plantings.

Survival of all species combined averaged 71 percent for released and 67 percent for unreleased. Survival during years of normal precipitation appeared slightly better on the unreleased plots, but after prolonged drouth survival was considerably better on the released plots. In the second and third year, mortality was generally low; redcedar and longleaf pine suffered the greatest losses. There are indications that on unreleased plots a dense low overstory causes higher mortality than a high overstory.

Damage by the pine tipmoth (Rhyacionia frustrana) and by the pine webworm (Tetralopha robustella) increased during the second growing season except on longleaf pine and redcedar, which are not susceptible to attack. For the second time, the released trees were hardest hit by the tipmoth, while webworm infestation was greatest on unreleased plots (table 4). Tipmoth damage to slash pine (which is usually immune) was generally confined to the lateral branches. On released pines, webworm attack was frequently confined to portions of the seedlings shaded by broomsedge or other vegetation. Although more trees are infested by tipmoth than webworm, damage caused by the latter is more serious. Tipmoth damage greatly reduces growth, but trees defoliated by webworm very frequently die.

Table 4.--Percent of living underplanted seedlings attacked by insects during second growing season

Species	Pine tipmoth		Pine webworm	
	Released	Unreleased	Released	Unreleased
	Percent			
Loblolly pine	81	28	5	20
Shortleaf pine	41	5	8	24
Virginia pine	86	29	5	31
Slash pine	16	13	6	11
All species	60	20	6	22

Early promise has also been shown by valuable hardwood species planted beneath a low-grade hardwood overstory on fair to good sites (see table 5) in north Mississippi.

Third-year survival of underplanted white ash, black walnut, white oak, yellow-poplar, and black locust has averaged 80 percent on released plots and 78 percent on those unreleased. Survival of released seedlings varied from 97 percent for white ash to 58 percent for black walnut. On unreleased plots, survival ranged from 94 percent for white ash to 63 percent for black walnut and black locust. Survival was highest on released upper slopes, where all species except black walnut averaged 96 percent or better. It was lowest on unreleased minor bottoms where heavy vegetative competition reduced average survival for all species to 65 percent, and black locust to 16. Except for black walnut, second- and third-year mortality of each species has been light on all sites other than minor bottoms.

Early release of underplanted seedlings, preferably before or immediately following planting, is desirable. Except for black walnut and white oak, released seedlings averaged two to five times the height of those unreleased, as shown by table 5. Yellow-poplar and black locust (Kimberley straight-stem variety), with average heights of 76 and 86 inches respectively when released, are the most promising of the hardwoods tested. They exceed even the 58-inch average for loblolly pine underplanted on the same areas.

Table 5.--Average height of underplanted seedlings after three growing seasons in north Mississippi

Species	Upper and middle slopes		Lower slopes and minor bottoms	
	Released	Unreleased	Released	Unreleased
	Inches			
White ash	29	11	32	11
Black walnut	21	16	32	23
White oak	17	13	17	13
Yellow-poplar	68	15	88	18
Black locust	79	20	94	16
Loblolly pine	64	21	52	16

South Mississippi.--Underplanted yellow-poplar on a moderately moist site on the McNeill Experiment Forest had a second-year survival of 72 percent. An overstory of low-grade hardwoods was deadened by Ammate before the seedlings were planted. Average height of seedlings after 2 years is 3 feet--enough to keep them ahead of competing vines and shrubs.

North Alabama.--Indications are that yellow-poplar seedlings planted under a low-grade hardwood overstory need release from all undesirable trees that are over 1½ inches in d.b.h. at the time of planting. When so released, plantings on bottoms and lower slopes grew to 11 feet in height in 4 years (table 6). On ridges and upper slopes, not much in the way of early growth can be expected from this species, even with release.

Table 6.--Average total height of yellow-poplar 4 years after underplanting

Treatment	Topographic position			Treatment average
	Bottoms and lower slopes	Upper slopes	Ridges	
	Feet			
Released	11.0	4.5	2.1	7.1
Not released	2.6	1.5	...	2.3

Central Louisiana.--A scrub oak stand in central Louisiana was underplanted in 1948 to slash, loblolly, and longleaf pine. Hogs destroyed the longleaf plantations, but the other two species did well. Different techniques, timings, and degrees of scrub oak removal were tested, and it appeared that deadening only competing oaks by girdling or poisoning was satisfactory, with best results when deadening occurred at about the time of planting or shortly thereafter. An article summarizing the results appeared on page 714 of the October 1951 issue of the Journal of Forestry.

Planting in north Arkansas

Miscellaneous plantings.--In plantings of various species and species groups in northern Arkansas, survival the first year after planting averaged better than 90 percent for unmixed plantations of black walnut, black locust, and white, pitch, and loblolly pines. Height growth varied from 0.16 foot for walnut to 0.96 foot for locust (table 7).

Table 7.--First-year survival and height growth of seedlings planted in north Arkansas

Species	Survival	Height growth
	Percent	Feet
Black walnut	97 to 98	0.16 to 0.20
White pine	96	.47
Pitch pine	95	.45
Loblolly pine	90	.60
Black locust	90	.93 to .96
Yellow-poplar	88	—.22
Black locust[1]	83	1.46
Virginia pine	78	.51
Shortleaf pine	62	.37
White oak	61	.14
Eastern redcedar[2]	35 to 53	.41 to .48

[1] Planted in alternate rows with redcedar.

[2] Planted in alternate rows with black locust.

The poor survival of shortleaf pine and eastern redcedar may have been due to inferior planting stock. Where planted in alternate rows with black locust, eastern redcedar had better survival and growth. The negative height growth for yellow-poplar was caused by dieback and resprouting from the root or stem. The maximum growth recorded for any individual broad-leaved seedling was 7.15 feet for a black locust. The maximum for a conifer was 1.60 feet for loblolly pine. White oak gave the lowest maximum height growth--0.55 foot.

Black walnut and black locust were planted in alternate rows as well as alone. However, as the ranges in table 7 show, there was little or no difference in survival or growth for either species when planted alone or in alternate rows.

Planting openings in redcedar stands.--It was found that when a source of shortleaf pine seed is nearby, openings in certain redcedar stands in north Arkansas are capable of regenerating to pine without planting. More than 1,000 shortleaf seedlings per acre became established 2 years after redcedar was spot-planted in natural and artificially created openings. In addition, about 1,000 redcedar seedlings per acre at least one foot tall became established even where no spot-planting of redcedar had taken place. Spot-planting established 600 to 900 additional redcedar seedlings per acre, but the planted trees merely raised the proportion of stocked milacres from 56 to 84 percent, and the former was considered adequate.

Redcedar tended to establish itself in openings that had been created by improvement cutting, while natural openings seemed to be somewhat more favorable for pine establishment. However, the difference in stocking between the two classes of opening was very slight when both species were considered.

Planting pine and redcedar in north Mississippi

Studies in north Mississippi and elsewhere have shown that eastern redcedar is a better soil builder than either shortleaf or loblolly pine. To compare soil changes under each of these vegetative covers, and to observe the growth and development of these three species in pure and in mixed plantations, study plots were established in 1950. The few trees that died the first year were replanted in 1951 to achieve maximum production of litter and heavy ground cover.

After two growing seasons, there are no appreciable differences in survival or degree of insect attack between the pure and mixed plantations. Overall survival is good: 76 percent for redcedar, 80 percent for loblolly, and 85 percent for shortleaf. Pine tipmoth attack is uniformly spread over both pure and mixed plantations; 88 percent of the loblolly and 60 percent of the shortleaf seedlings are infested. The pine webworm has attacked 5 percent of the loblolly and 7 percent of the shortleaf seedlings.

Cottonwood planting in the Mississippi Delta

Spot-planting tests conducted on the Delta Experimental Forest indicate that partial planting of recently logged areas, using cottonwood cuttings, is possible without special site preparation and cultivation. Planting should be made the first spring after logging, in openings that have been thoroughly scarified by the logging operations and thus are free from weeds and vines.

Shade had a marked effect on survival and height attained by such cottonwood plantings during the first growing season (table 8). The results so far suggest that planting in the edge of openings under high shade be avoided because weeds and brush can easily spring up and cause the bad combination of high and low shade.

In cooperation with private landowners, cottonwood plantings were made on two sizeable areas in 1951. One planting (on batture land) with 6- by 10-foot spacing resulted in 85- to 90-percent survival. Height growth varied from 20 to 89 inches because of a range in soil conditions. The other planting, near Indianola, Mississippi, showed only fair survival and growth because of a severe summer drouth.

Table 8.--Height and survival of cottonwood cuttings one year after being planted in forest openings

Type of shade	Survival	Height
	Percent	Inches
No shade	81	43
High shade from edges of openings	60	30
Low shade from weeds and vines	50	30
High shade and low shade	40	25

Two 1950 cooperative plantations failed because they were not cultivated properly. Deer caused the failure of a 1948 plantation in a minor stream bottom in northeast Mississippi.

Planting dawn redwood in the Mississippi Delta

In cooperation with Professor Ralph W. Chaney of the University of California, 50 dawn redwood seedlings (*Metasequoia glyptostroboides*) were planted near Stoneville, Mississippi, on the edge of sites where baldcypress is known to have thrived. Unfortunately, the trees were small and were not received till the end of March, by which time they were in full leaf. A cold spell immediately following planting and a 27-year record drouth from May through August caused heavy losses; and the seedlings that survived these hazards were wiped out when a sudden drop to 20° F. occurred in the fall, before the new growth could harden off. The test will be repeated in 1952.

Planting strip-mined areas in north Alabama

Loblolly pine appears to be the best tree species to plant on newly created spoils banks in northern Alabama. After five years, test plantings of this species average 8.2 feet in height and have a survival of 86 percent. Shortleaf pine has a height of 5.4 feet and a survival of 69 percent. Longleaf pine has an average height of only 3.1 feet and a survival of 19 percent. Fertilization of loblolly pine did not improve height growth enough to warrant recomendation.

Along the margins of ponds created by strip mining, sycamore made an excellent showing, with an average height of 10.1 feet and survival of 93 percent. Although sweetgum was not planted, observations of natural seedlings indicate that it might also be a good species to plant on these moist sites.

Other species tested but not recommended for planting on spoil banks are white and green ash and tupelo gum.

Spot seeding of the three pine species was also tested, but resulted in complete failure in all cases.

The above results and recommendations apply to newly created (1-year-old) spoil banks only. On older and more stable banks, direct-seeded or planted longleaf pine might make a better showing. Further, while the survival and growth of shortleaf pine have been satisfactory to date, the nearby presence of littleleaf disease makes this species a poor risk for any type of planting in this area.

Late planting of loblolly pine

Tests in two successive years indicate that in north-central Alabama loblolly pine should be planted not later than about May 1 if reasonable survival and height growth are to be expected. This recommendation applies particularly to seedlings stored in a heel-in bed until planted. When growth of the heeled-in seedlings began to accelerate, the success of the planting began to diminish.

A small supplementary test failed to determine conclusively whether the use of refrigerated stock would extend the planting season beyond May 1.

Planting longleaf on old fields in south Mississippi

Ten years after a longleaf plantation spaced 6 feet by 6 feet was set out in south Mississippi, a comparison between plots on old fields and plots on cut-over land indicates that old fields were much the better of the two situations. Survial did not differ greatly--43 percent on cut-over land and 39 percent on old fields--but there were large differences in the number of trees above 3 feet tall. The old field had 406 such trees per acre as compared to only 187 per acre on the cut-over. The average height of these 406 trees on the old fields was 18 feet, while the 187 trees on the cut-over plots averaged only 11 feet high.

It seems likely that brown spot disease and brush competition in the cut-over land account for much of the difference.

Stimulating height growth of longleaf plantations

Spraying with Bordeaux mixture for brown-spot control was continued through the third growing season in a 6-acre longleaf plantation in central Louisiana. Results were good. Though a detailed analysis of data has not been completed, sprayed seedlings appear to have started height growth faster than unsprayed ones did. At present, however, spraying costs too much for widespread use.

Both fertilizing and prescribed burning a year after planting improved the growth of longleaf seedlings in southern Mississippi. The seedlings were planted in the spring of 1946. Before the burn in March 1947, 20 percent of the needles had been killed by brown spot. Apparently 1947 was a year of rapid spread for this disease. A year after burning, the needle-kill had increased to 72 percent, but it rose to 82 percent on the unburned checks in the same period. Two years after the fires, the defoliation was 81 percent on unburned and 85 percent on burned seedlings. It continued to be severe in the next two years. As table 9 indicates, however, the relatively slight advantage enjoyed by the burned seedlings noticeably improved height growth.

In the same test, several different fertilizers were applied at the rate of about 1 gram of elemental nitrogen per seedling. To avoid the rapid weed and grass growth that usually results from broadcast fertilizing, the fertilizer was placed near each seedling in 3 holes, each about 4 inches deep and 3/4 inch in diameter. No fertilizer had any effect on seedling survival. Fertilized seedlings grew significantly better than unfertilized, but no single fertilizer seemed better than any other.

Table 9.--Heights of longleaf seedlings 5 years after planting

Treatment	Fertilized	Not fertilized	Average
	Feet		
Burned	0.60	0.38	0.56
Not burned	.49	.31	.46
Average	.55	.35	.51

Heights five years after planting were not impressive, but indicate that it may be possible to develop fertilizer practices which will stimulate the height growth of longleaf seedlings.

Stimulating longleaf seed production

Either fertilization or release will stimulate cone production of second-growth longleaf stands. In a test at two locations in south Mississippi and one in south Alabama, some 8- to 12-inch trees were released in 1948 and some were fertilized with a complete mineral fertilizer in both February 1949 and 1951. In 1951, released trees averaged 11 cones apiece; fertilized trees 25 cones each; and trees both released and fertilized, 27 cones each. Trees that were neither released nor fertilized had 2 cones apiece (table 10).

Table 10.--Number of longleaf pine cones per tree by size and treatment

D.b.h. class (inches)	Treatment				Average
	Control	Released	Fertilized	Released and fertilized	
	- - - - - Number of cones per tree - - - - - - -				
8	1	4	10	17	8
10	2	18	26	28	18
12	3	12	39	37	23
Average	2	11	25	27	16

Large trees appear to be more desirable for seed production. In 1951, 8-inch trees averaged 8 cones per tree; 10-inch trees 18 cones; and 12-inch trees 23 cones. Ten 12-inch trees per acre, according to this test, would have produced over 16,000 seeds per acre (enough for satisfactory natural regeneration) in a year when the control trees indicated a light seed crop.

Past cone production also is indicative of current seed production. Half of the trees in this test produced no cones in 1948; they averaged 8 cones apiece in 1951. The trees that had produced cones in 1948 averaged 25 apiece in 1951.

Genetics

Geographic races

The Southern Forest Experiment Station has participated in the work of the Committee on Southern Forest Tree Improvement since the Committee's inception at Atlanta, Georgia, on January 9 and 10, 1951. The major effort of the Southern Station has been to plan and negotiate a South-wide cooperative study of the effect of geographic source of seed of the four principal southern pines.

Cooperators in fifty-two carefully selected localities from Pennsylvania and New Jersey south to southern Florida and west to Texas, Oklahoma, and Missouri have contributed seed for this study. The Station has provided special cleaning, over-winter storage, and distribution to twenty forest tree nurseries in 16 southern and eastern States. Near each of the fifty-two collecting grounds it is planned to make test plantings to compare the growth of stock from local seed with that from seed collected at five to seven places having different soils or climate.

In cooperation with the TVA, the Southern Station in 1950 planted loblolly seedlings raised from seed gathered at nine different geographic sources. The Station's plantings were made in north Arkansas, north Mississippi, and north Alabama; other cooperators planted at 5 additional locations.

By the end of the first two growing seasons, North and South Carolina seed sources had almost completely failed at all 8 locations. The reason is not known, as lots from these areas have done quite well in other tests. Of the remaining lots, height growth of progeny from north Alabama was best and from Maryland was worst in both north Alabama and north Arkansas. In north Mississippi, height growth was best from east Tennessee stock and worst from Virginia stock. Possibly differences in size of stock, nursery treatment, or tipmoth damage explain some of the contrasts.

In south Mississippi, two years after outplanting, 58 percent of longleaf seedlings from Alabama seed sources have initiated height growth as compared with only 39 percent of those from Mississippi sources. Observation over a period of years will be necessary to ascertain whether trees from Alabama seed sources maintain this superiority, but in plantations established in each of two different years they enjoyed almost a 20-percent superiority.

Hybridization

After three growing seasons, several backcrosses of loblolly-shortleaf hybrids to either parent have failed to grow as well as the loblolly parent in Arkansas, Alabama, or Mississippi. The crosses, which were made by the Institute of Forest Genetics at Placerville, California, seem to be intermediate between the parents in both survival and height growth. None of this group of crosses may prove commercially important, but they are of technical interest.

During the past year a small-scale attempt to hybridize a number of species of pine was made in south Mississippi and in central Louisiana. Current observations indicate considerable loss from insects in south Mississippi, but it is hoped that some crosses may yield seed that will mature in the fall of 1952.

Silviculture

Commercial intermediate cuttings (salvage, improvement, thinning)

Bottomland hardwoods in Mississippi Delta.--The year 1951 saw the completion of Occasional Paper 116, "Management of bottomland hardwoods." The paper discusses procedures for gathering essential data and organizing the forest property, and describes bottomland hardwood sites and types. Particular attention is paid to the conversion of unmanaged stands through commercial salvage and improvement cuttings. To this end, the paper outlines silvical situations and suggests levels of growing stock to be used as guides for intermediate commercial cuttings. A chapter is devoted to general information on regeneration, and the appendix summarizes the chief uses and silvical characteristics of the important bottomland species.

An article entitled "Improvement cutting in bottomland hardwoods" appeared on page 195 of the Southern Lumberman for December 15, 1951. It sums up observations on plots established 10 years previously. The study showed that removal of undesirable trees concentrated the growth on fast-growing, desirable poles and young saw-timber trees. Growth of the released trees was very satisfactory.

Demonstrations of good technique in salvage and improvement cuttings were established in cooperation with several large ownerships. Remeasurement of a 55-year-old cottonwood stand thinned several years earlier emphasized the fact that failure to salvage poor-risk trees at the time of marking could lead to mortality amounting to 1/3 of the growth in the subsequent 4 or 5 years. When they were thinned, the trees averaged 27 inches in d.b.h. and had about four 16-foot logs apiece.

In 1947 some stands of medium-sized sweetgum and water oak saw timber were given a salvage and improvement cut. Observations in 1951 indicated that suppressed sweetgum had failed to recover after release, and that when suppressed pole-sized willow oak and Nuttall oak were released, excessive "feathering" took place along the bole. This indicates that willow and Nuttall oak to be released should be selected from among dominants and codominants wherever possible.

Longleaf salvage and improvement cutting in south Mississippi.--Periodic growth of pole-sized longleaf stands in south Mississippi given a salvage and improvement cut 3 years ago has ranged from 0.4 cord to 1 cord per acre per year; the average is 0.6 cord. Growth has tended to be proportional to the residual stand left after cutting; the periodic annual growth rate has been 3.5 percent. For five years in a row, mortality attributable to the black turpentine beetle has been observed in these stands, and only a portion of it has been salvagable.

Commercial cutting in loblolly-shortleaf stands of east Texas.--Data on logging costs and first-year mortality subsequent to logging were byproducts of a long-term comparison of all-aged and even-aged management systems in shortleaf-loblolly stands of east Texas.

Where local east Texas Doyle scaling practice was employed, the cost of logging (exclusive of truck haul) could be estimated (with a standard error of ± $0.15) by the following formula: Cost of logging in dollars per MBF =

$$10.70 + \frac{1{,}100}{\text{bd. ft. cut per av. acre}} - \frac{\text{bd. ft. vol. of av. log removed}}{10}$$

Thus, volume of average log exerted more influence on cost than did volume cut per average acre, as long as cut per acre did not drop too much below 1,100 board feet. An increase of 10 board feet in volume of the average log reduced cost of logging $1.00 per MBF, whereas increasing the cut per acre from 1,100 to 6,600 board feet reduced costs only 83 cents. An article summarizing the cost data appears on page 76 of the Southern Lumberman for February 15, 1952.

Mortality during the first year after logging amounted to 61 board feet per acre, scattered so that only 1/6 was commercially salvagable. Bark beetles (principally Ips) accounted for loss of 38 board feet per acre, windstorms accounted for loss of 14 board feet per acre, logging damage accounted for loss of 6 board feet per acre, and lightning and disease caused the remainder. An article discussing this mortality appeared on page 256 of the Southern Lumberman for December 15, 1951.

Loblolly thinning.--Thirty-six years of observations have been recorded on the Maxwell plots near Urania, Louisiana. The stand, of old-field loblolly pine, was 8 years old in 1915 when a check plot and a pre-commercial thinning plot were established. In 1925, when the stand was 18 years old, it was ready for commercial thinning; at this time 3 more plots, thinned according to different criteria, were installed. A very heavy "crop-tree" thinning made at that time was not recut until 1951, and the check plot has never been cut. The other three plots have been thinned periodically at 5- to 10-year intervals.

The results indicate that for 30- to 35-year pulpwood rotations, very light thinning or no thinning at all may produce the greatest volume. For longer rotations, failure to anticipate mortality may result in considerable loss. Precommercial thinnings do not appear advantageous, nor does the crop-tree thinning. After age 35, the periodic heavy thinning resulted in the best diameter growth rate, although periodic light thinnings produced the most wood. Periodic light thinning from above caused the most rapid improvement in quality. A manuscript giving detailed records will be published in the Journal of Forestry.

The Castor plots, also established in 1915 in an old-field loblolly stand in a small creek bottom near Urania, corroborate the general conclusions of the Maxwell plots. Periodic light thinning has produced the most cubic volume growth, periodic heavy thinning the most sawlog growth and the fastest diameter growth. The check plot has lost considerable volume through mortality and stagnation. One of the most interesting facts is that on this good site, the lightly thinned plot has averaged 2.2 cords of growth per acre per year, or 760 board feet per acre per year for 57 years. Over the past 5 years, periodic annual growth has averaged nearly 1,200 board feet per acre per year. The sawlogs are of good quality, and the proportion of high-grade logs is rapidly increasing. The moral is plain: concentrating intensive forestry efforts on the best sites is apt to bring in much greater returns than dissipating them over poor and good sites alike. Detailed data on the Castor plots appeared on page 14 of Forests and People for January 1952.

Longleaf thinning in south Alabama.--Analyses of the Loxley plots, established in a 22-year-old longleaf pine stand in Baldwin County, Alabama, in 1933-34, indicate that an early precommercial thinning at age 22 might have been justified. If the stands had been reduced from over 1,500 trees to 900 to 1,200 trees per acre, they would have had sufficient room to make good growth until they reached a size where commercial thinning would have been practical. These plots (see page 15 of the 1950 Annual Report) were the subject of two detailed articles, on page 790 of the November 1951 Journal of Forestry, and on page 168 of the Southern Lumberman for December 15, 1951.

Noncommercial cutting or deadening to release desirable growing stock (TSI)

TSI in south Arkansas.--Removal of undesirable hardwoods on millions of acres of pine lands throughout the South continues to be an important forest problem. Studies under way at several branch stations are giving some results.

At Crossett, Arkansas, 4-year results of the 1947 study of the use of Ammate to eliminate unwanted hardwoods from pine stands are as follows (see also table 11):

19-percent Ammate in frills at 30 inches above the ground line gives quick and excellent kill. It is useful where pine reproduction is present and quick release is desired. It is as effective as the more expensive 38-percent solution. Sprouting frequency and size were about the same as on trees frilled but not poisoned.

Ammate crystals in cups (notches) at ground level give satisfactory kill and almost complete elimination of sprouts on post and southern red oak under 10 inches in d.b.h. This method is useful where pine reproduction is absent but seed trees are present. It is the most expensive method.

Ammate crystals in cups at 30 inches is not recommended. Satisfactory kill is limited to hardwoods less than 7 inches in d.b.h.

Frilling alone gives good ultimate kill on trees less than 10 inches in d.b.h. It is the cheapest method of release where advance pine reproduction is at least 3 feet high, but the treated trees may sprout later.

Two-hack girdle without Ammate, though not included in this test, effectively kills hardwoods 10 inches d.b.h. and larger; sprouting is negligible.

Table 11.--Costs of various Ammate treatments[1] per acre, Crossett, Arkansas

Treatment	Man-hours	Ammate used	Total cost[2] per acre at wage rates of-- 75 cents per hour	85 cents per hour	Comment
		Pounds	- - Dollars	-	
Frill only	2.22	...	2.19	2.43	Cheap, but trees may sprout later
Two-hack girdle	3.85	...	3.80	4.20	For hardwoods over 9 inches d.b.h.
Frill, 19 percent Ammate	3.67	3.1	4.08	4.47	For quick, thorough kill
Ammate crystals in cups at 30 inches	2.44	12.4	4.27	4.52	Ineffective
Frill, 38 percent Ammate	3.67	7.7	4.78	5.17	Too expensive
Ammate crystals in cups at ground	3.00	12.4	4.82	5.14	Where advance reproduction is absent

[1] Basis: 190 trees per acre from 1 to 13 inches in d.b.h. and averaging 5.1 inches.
[2] Ammate at 15 cents per pound, and overhead at 23.6 cents for 75-cent wage rate and 24.2 cents for 85-cent wage rate.

A second and more complete study was established at Crossett in May 1950. Indications 18 months after treatment are that a 10.7-percent solution of Ammate in a frill may be as effective on 3- to 10-inch red oaks and post oaks as the 19- and 38-percent concentrations. For 1- and 2-inch trees, early indications are that

2 pounds of Ammate to the gallon of water, applied with a Cornell tool (giving a 1-inch tree two jabs and a 2-inch tree three jabs) may be the best method.

Tests of 2,4,5-T alone and in combination with 2,4-D were established in May 1951. After five months, 1- and 2-percent solutions of either, applied in frills, have given an excellent kill (averaging 92 to 95 percent) and few sprouts (sprouts appeared on 6 to 24 percent of the stems treated).

Large-scale timber stand improvement work has been carried on near Crossett since 1937. Some of the benefits of this early work are set forth in two articles--one on page 250 of the April 1951 Journal of Forestry, the other on page 237 of the Southern Lumberman for December 15, 1951.

TSI in east Texas.--Near Nacogdoches, Texas, Ammate crystals are being tested in notches near the ground and at convenient chopping height. After two years, the low treatment is definitely more effective both in controlling sprouting on 2- to 7-inch southern red or post oaks and sweetgum and in killing crowns of oaks.

Stand improvement studies in bottomlands on the Stephen F. Austin Experimental Forest, near Nacogdoches, provided a comparison of the time required for double-hack or notch girdling with that for frill or single-hack girdling. Basal area treated per man-hour was 22 percent higher for frill girdling, and number of stems treated was 34 percent higher. Table 12 summarizes pertinent data for the two methods.

Table 12.--Comparison of two methods of girdling bottomland hardwoods in east Texas

Item	Method	
	Double-hack	Frill
Basal area treated per man-hour	11.7 sq. ft.	14.2 sq. ft.
Number of stems treated per man-hour	17.0 stems	22.8 stems
Average number of stems treated per acre	58.9 stems	58.9 stems
Average d.b.h. of tree	11.2 inches	10.7 inches

Response of pine to release is evident on the 1947 hardwood control treatments on the Stephen F. Austin Experimental Forest. In four years, non-released trees grew 1.6 feet in height; partially released trees grew 3.9 feet; and fully released trees, 4.9 feet. More detailed information will be available after the fifth-year remeasurements.

TSI in north Mississippi.--Studies near Oxford, Mississippi, indicate that single-frilling is more effective than Ammate in notches for killing undesirable upland hardwoods. Thirty-two months after treatment, 99 percent of the frilled trees have crowns more than two-thirds dead. The corresponding figure for Ammated trees is 81 percent. These results differ from earlier ones: twelve months after treatment only 54 percent of the frilled trees were two-thirds dead as compared with 69 percent of those poisoned.

Less than one percent of the poisoned hardwoods had sprouted by the end of the third summer after treatment. Sprouting was more common on frilled trees, occurring on 54 percent of the girdled trees 4.8 inches in d.b.h., on 11 percent of those 9 to 12 inches in d.b.h., and only on 3 percent of those 13 inches d.b.h. and larger. Some sprouts on both girdled and poisoned trees died during the third summer.

Damage caused by limbs and trees falling on the pines beneath became progressively worse as the deadened overstory disintegrated. The pines were eight years old when they were released. At the end of the second year after treatment, seven pines per acre had been killed or severely damaged under the poisoned hardwoods, as compared to 12 per acre beneath the girdled trees. Thirty-two months after treatment, the number of killed or severely damaged pines had increased to 57 per acre (almost 10 percent of all pines released) under poisoned hardwoods and 52 per acre under those girdled.

In another study in north Mississippi, planted loblolly pine that had grown for eight years under a hardwood overstory showed a decided response to release. Two years after treatment, basal area on released plots had increased an average of 13.5 square feet per acre, or 221 percent of the original, as compared with an increase of 5.5 square feet, or 89 percent, on unreleased check plots. During the two years, the pines on released plots increased an average of 1.1 inches in d.b.h. and 5 feet in height. The unreleased pines grew 0.6 inch in d.b.h. and 4 feet in height.

The benefits of the release are much more pronounced on the 100 tallest trees per acre, which presumably will constitute the majority of the final crop. These released dominant trees increased 1.4 inches in diameter and 7 feet in height, while unreleased dominants grew only 0.8 inch and 4 feet. The increase in growth was slightly higher on girdled trees than on poisoned ones because the girdled overstory shaded 92 percent of the pines originally planted and the poisoned overstory shaded only 70 percent originally.

TSI in north Alabama.--Several intensities of timber stand improvement were applied over 184 acres of mixed pine-hardwoods on the Flat Top Experimental Forest near Birmingham, Alabama. Before treatment, the average basal area in trees over $3\frac{1}{2}$ inches d.b.h. was 29 square feet of pine and 28 square feet of hardwood. An average of 0.2 man-hour per acre was needed to girdle all cull hardwoods (2.5 per acre) over $9\frac{1}{2}$ inches in d.b.h. Girdling all cull hardwoods over $5\frac{1}{2}$ inches d.b.h.--there were 12.3 such trees per acre--required 0.5 man-hour. Girdling all hardwoods (112 per acre) over $3\frac{1}{2}$ inches d.b.h. required 3.2 man-hours.

The study indicated that girdling time was related to the number of trees treated and to the sum of their diameters. By regression analysis, a formula was derived that predicted time in man-hours per acre from N (number of trees girdled per acre) and sum D (the sum of d.b.h.'s girdled per acre, in inches). The formula, which can be applied to other hardwood stands where crews of similar efficiency may work, is:

$$\text{Man-hours per acre} = .006005\,(\text{sum } D) - .010066(N)$$

A slightly less accurate but even simpler prediction was made by multiplying sum D by .005 man-hour.

Where woods labor works faster or slower than in this study, the constants given above should be changed to those appropriate to local crews. However, in two quite dissimilar operations in southern Arkansas, the required times differed less than 5 percent from those estimated by the use of the Alabama constants.

TSI timing in south Alabama.--Some natural longleaf pine reproduction in south Alabama under a scrub oak canopy was released when one year old, while other one-year-old longleaf reproduction was not released. Ground-line diameter growth in the second year was over twice as great on released trees as on those not released. Some unreleased two-year-olds were then released, and their diameter growth in their third year was the same as that of trees released one year earlier and almost twice as great as that of trees never released. The one-year delay in release reduced growth for one year but so far does not appear to have crippled the current growth potential of the seedlings after release.

TSI in north Arkansas.--In 1934, some hardwood crop trees were released in dense young stands on the Sylamore Experimental Forest. A moderate to dense overstory, however, was left on all the treated areas. The crop trees were mostly white and black oaks about 2.2 inches in d.b.h.

During the first five years after 1934, the crop trees under a moderate overstory made almost double the diameter growth of the unreleased trees. Under a heavy overstory little or no effect of release was noted in the first five years, and there was a marked decrease in growth during the next 8 years.

In 1948 the crop trees were reselected and several new release treatments were carried out. All of the new treatments (see table 13) have promoted the growth of the crop trees. The response has been best where both the overstory and the understory were removed; here, diameter growth since 1948 has been almost triple that on the unreleased plots.

Table 13.--Effect of release on periodic average annual d.b.h. growth of crop trees in north Arkansas

Treatment	Annual d.b.h. growth During 1934-1939	 During 1939-1947
	- - - Inches	- - -
Released in 1934		
Crop trees released but with moderate overstory	0.17	0.14
Crop trees released but with heavy overstory	.11	.09
No release	.10	.08
	Previous to 1948	During 1948-1951
	- - - Inches	- - -
Released in 1948		
Removal of overstory and understory around crop trees	.13	.26
Removal of overstory and light freeing of crop trees in understory	.13	.21
No removal of overstory but all understory removed around crop trees	.06	.15
No release	.09	.09

The large diameter growth of crop trees on plots where both the overstory and the understory were removed was accompanied by a large increase in epicormic branching along the boles of the trees, especially in white oak. Whether or not this branching will affect the usefulness of the white oak for bourbon staves remains to be determined. The saplings on the completely released plots are still small, so that the branches will not cause serious damage unless they persist.

The study corroborates previous opinions that complete liberation from overstory and cleaning in the understory will appreciably stimulate growth in sapling stands.

An article appraising the 15-year results of timber stand improvement work conducted by the Civilian Conservation Corps in 1933 on the Ozark National Forest in Arkansas appeared on page 163 of the Southern Lumberman for December 15, 1951. The article infers that cleaning in the understory of a 2-storied hardwood stand was worth while only when accompanied by heavy liberation from the undesirable overstory. Also,there are indications that liberation cutting of overstory hardwoods in sparse pine stands did not open up the stand sufficiently to allow additional pine reproduction to become established unless the hardwood understory was treated. In general, hardwood types benefitted both in composition and growth-stimulation from the 1933 treatments. The need for getting rid of unmerchantable culls was quite apparent. Chinquapin and red maple were the only species that sprouted vigorously after girdling; where these species must be treated, chemicals should be applied to inhibit sprouting.

Recently, timber stand improvement incorporating the lessons above was accomplished on 1,116 acres on the Sylamore Experimental Forest. The whole operation involved 3,200 man-hours of labor and 5,500 pounds of ammonium sulfamate crystals. Average cost was $3.38 per acre. Where only the undesirable hardwood overstory larger than $9\frac{1}{2}$ inches in d.b.h. was treated, the labor averaged $1.43 per acre and the poison cost $0.44. Where all undesirable hardwoods larger than $1\frac{1}{2}$ inches in d.b.h. were treated, labor cost $6.35 per acre and poison $2.80 per acre.

Pruning desirable growing stock

Pruning old-field loblolly in south Arkansas.--Loblolly pines in plantations and in old-field stands are generally very limby in early years. Pruning appears to afford an excellent chance to improve the quality of such trees at a reasonable cost per acre. To determine to what degree pruning improves quality, a study was installed at Crossett, Arkansas, in 1933, in an 8-year-old stand of old-field loblolly pine. Trees were very rough; many had live branches entirely down the bole. One plot was thinned heavily and the remaining 298 trees (except 8 suppressed ones) were pruned to a height of 17 feet. Most pruned trees retained 40 percent or more of their total height in live crown. On the other plot, thinning was deferred until 1946 and none of the trees have been pruned.

Pruning did not retard cubic volume growth or diameter growth of the treated trees. Cordwood growth over the 18-year period has averaged 1.71 cords per acre yearly on the pruned plot as compared to 1.67 cords on the unpruned plot. During the same period, average annual diameter growth of the 100 largest trees per acre was 0.25 inch yearly on the unpruned plot and 0.24 inch on the pruned plot.

It now appears that heavier or more frequent thinnings were needed on the pruned plot to keep treated trees growing rapidly in diameter, even if some cordwood production was lost. Unless the pruned trees are given nearly all the growing space they can use, the increase in the volume of the part of the bole from which clear lumber can be obtained may be small. Consequently, pruning without thinning may not be very profitable in dense stands.

Examination of nearly 100 pruned knots from felled pruned trees showed that branch stubs up to one inch in diameter required 1.2 inches of diameter growth for complete healing. Stubs 1 to 1½ inches in diameter required 1.5 inches of diameter growth, and 1½- to 2-inch stubs needed 1.8 inches. This means that if trees are growing at the rate of 3 inches d.b.h. in 10 years, it will be 4 years before knot-free wood is laid on over 1-inch branch stubs. Branch stubs 2 inches in diameter will take 6 years to heal completely. Pruning should therefore be started early, when branches are small. Not only will the smaller branch stubs heal over more quickly than large ones, but the work will be cheaper and easier.

An article based on this and other loblolly pruning studies was published on page 5 of the Forest Farmer for September 1951.

Bud-pruned loblolly in north Alabama.--In an exploratory test of bud-pruning near Birmingham, Alabama, the height growth of bud-pruned loblolly pine in an old field was no less that that of unpruned trees. The trees were two to five feet tall before pruning. Some were pruned the entire length of the stem, and some all but the basal 2½ feet. The latter group grew best, averaging 3½ feet of height growth in 1951.

Pruning open-grown longleaf pine in central Louisiana.--A study near Alexandria, Louisiana, in which nearly 5,000 seventeen-year-old planted open-grown longleaf were pruned, showed that pruning can be done at a modest cost. One hundred trees per acre (averaging 5 inches d.b.h.) were pruned to a height of 17 feet with a pruning saw mounted on a sectional aluminum pole. Labor--including time for walking and delay--averaged 5.36 man-hours per acre.

The cost of pruning to a height of 17 feet increased directly in proportion to the tree diameter. It required 3 minutes or a cost of 4 cents to prune a tree 4 inches in d.b.h.; 4 minutes or 5½ cents for a 6-inch tree; and 6 minutes or 8 cents for an 8-inch tree (wages computed at 80 cents per hour). Thus, it costs twice as much to prune an 8-inch tree as a 4-inch tree. Moreover, pruning small trees means that the knotty core will be smaller and the ultimate yield of clear lumber much greater.

Pruning higher than one log is costly and tedious. On trees averaging 4.4 inches in d.b.h., it took 67 percent more labor to prune to an average height of 23 feet than to 17 feet.

The 1951 ice storm occurred a few weeks after pruning was completed. About 16.5 percent of the unpruned trees were ice-damaged, while 18 percent of trees were damaged if pruned selectively to one log without reducing live crown below 35 percent of total height. Trees pruned indiscriminately to a height of one log suffered over 24 percent damage; but in many of these trees, pruning had reduced the live crown ratio far below 35 percent. From this, it seems evident that judicious pruning, leaving at least one-third of the total height in live crown, will not result in greatly increased ice breakage.

Silvics

Cone production of longleaf seed trees in south Alabama.--Seed-tree cuttings in south Alabama over the last 3 years have indicated that cone production increases with time since release. Approximately 10 longleaf trees per acre were left in cuttings in 1948, 1949, and 1950. The 1951 cone production averaged 60 cones per tree on those released for 3 years, 28 per tree on those released for 2 years, and 15 per tree on those released for one year.

Cone production of loblolly seed trees in south Arkansas.--At Crossett, Arkansas, as in earlier observations in the southeastern United States, it was found that tree d.b.h. and past history of cone production were the best clues as to whether a loblolly pine would be a good cone producer. Crown density, crown area, or tree age did not prove well correlated with cone production.

Out of 56 trees released from competition in 1949, 44 bore cones in 1951. The average was 77 cones per tree and the maximum, 581. Seventy-five percent of the trees larger than 11½ inches in d.b.h. bore at least 25 cones per tree, while only 16 percent of the smaller trees reached or passed this mark. Ninety-five percent of the trees which bore cones previous to 1949 bore them again in 1951, but only 70 percent of those coneless before 1949 were cone-bearers in 1951, and the average number of cones per tree for the beginners was only 29 percent of the average for the veteran bearers.

Seed production of shortleaf in east Texas.--1951 was an unusually good shortleaf seed year in east Texas. Forty-eight ¼-milacre seed traps caught a total of 8,979 pine seed from October 15 to December 4, in a variety of stands in which the same traps over a longer period caught only 34 seeds in 1950. Seventy-six percent of the seed fell between November 12 and November 19, with the remainder falling evenly before and after. About 1 percent of the total fall was loblolly pine seed.

Differences in amount of seed per acre produced by stands which had been cut differently were noticeable, but the bumper year produced adequate seed regardless of cutting method. Shelterwood cutting plots on which 30 trees per acre had been left had 1,300,000 seeds per acre; selection cutting plots had 600,000 seeds per acre; plots that had been clear-cut in strips had 340,000 seeds per acre. (The strips, which were 4 chains wide, had been clear-cut over a 2-year period.)

Competition effects on loblolly reproduction in south Arkansas.--At Crossett, half-acre, quarter-acre, and eighth-acre openings were made in an old-field loblolly stand 55 years old. One-year-old seedlings from the 1947 seed crop were measured and permanently marked. After two years, some retardation of seedling growth due to the surrounding forest was noted in all three sizes of opening. Retardation extended to the center of the eighth-acre opening, inwards for 45 feet into the quarter-acre opening, and inwards for 30 to 35 feet into the half-acre opening. The study will be continued to ascertain the progress of seedlings and the zone where mortality is reasonably certain.

Another study of loblolly reproduction in the same general area involved all combinations of presence or absence of the following treatments: severing roots of competing hardwood brush, tying back crowns of competing hardwood brush to allow full light, and watering when soil moisture dropped below 12 percent. Although root competition appeared to be more serious than crown competition during the first year, competition for light proved to be the limiting factor over a three-year period. Watering was rarely required, but since the three-year period may have had unusually favorable water conditions, the study will be repeated.

Competition effects on longleaf reproduction in south Mississippi.--Root competition in moderately stocked stands of pole-sized longleaf pine in south Mississippi appears to be responsible for both mortality and slow growth of longleaf seedlings. A study of trenched versus untrenched milacres on the McNeill Experimental Forest indicates that survival in 1951 of seedlings established in 1947 was 90 percent on the trenched plots and only 58 percent on the untrenched; 1951 survival of 1948 seedlings was 73 percent on the trenched plots and only 58 percent on the untrenched. Ground-line diameter of the trenched seedlings was about 2 1/3 times as great as that of the untrenched seedlings in each case.

This demonstrates that advance longleaf reproduction can survive for some time under shade, but that root competition from nearby residual stands will seriously retard its development. Use of cutting methods creating large openings and removal of seed trees or shelterwood soon after seedling establishment seem to be indicated.

Sheep damage to longleaf reproduction in south Mississippi.--Observations on cut-over lands in the DeSoto National Forest indicated that when longleaf is less than 4 feet tall, height growth where sheep are permitted may be 25 percent less than where they are excluded. Sheep browsing did not cause serious mortality, but it deformed 15 percent of the seedlings so seriously as to destroy their potentiality for crop trees. Winter browsing caused the greatest damage. Observations extended over a period of seven years, and were made in plantations as well as in areas of natural reproduction. Details of the findings appear on page 278 of the April 1951 Journal of Forestry.

Site-species correlation in north Arkansas.--Current observations of tree species occurrence and geological formation in the north Arkansas Ozarks indicate that on most shallow soils eastern redcedar is the species that will have the best potentiality under management. Pine, however, is to be preferred on shallow south or west slopes derived from Cotter chert and dolomite, Boone chert, or Batesville sandstone.

On most deep soils either hardwoods or pine may be preferable, with hardwoods tending to dominate north or east slopes and pine south or west slopes. An exception to this statement is that eastern redcedar seems to be preferable on deep soils derived from Fayetteville, Moorefield, or Chattanooga shale, Boone and St. Joe limestone, Powell or Cotter dolomite.

Rehabilitation of forest soils.--A comparison of the properties of firm and medium mull, two of the principal humus types in forest soils in north Mississippi, showed medium mull to be far superior in many important respects (table 14).

Table 14.--Characteristics of firm and medium mull in north Mississippi

Property	Unit	Medium mull	Firm mull
Total depth	Inches	2.2	1.5
pH	...	5.06	4.60
Exchangable calcium	Milligram equivalent per 100 grams	6.42	1.86
Air-filled pores	Percent by volume	61	52
Bulk density	Grams per cc.	.80	1.04
Total porosity	Percent by volume	73	63
Air volume at field capacity	Percent by volume	51	39
Infiltration time of one inch of water	Seconds	101	2,050

Dry weight of Sudangrass grown on medium mull was considerably more than that grown on an equal area of firm mull. An account of the study appears on page 222 of the Journal of Forestry for 1952.

An informal investigation in north Mississippi was conducted on old-field Grenada and Lexington soils under 10-year-old loblolly. An underlying hardpan made the Grenada soil much less favorable for tree development than the Lexington, but the upper horizons of the two soils did not differ greatly in physical characteristics.

The grasses and legumes planted in north Mississippi during 1947 and 1948 were re-examined with a view to determining their potentialities for erosion control. Of the 50 species planted, 15 are still alive despite heavy competition from broomsedge and crabgrass. Most successful are: weeping lovegrass (*Eragrostis curvula*), little bluestem (*Andropogon scoparius*), decumbent lespedeza (*Lespedeza latissima*), big trefoil (*Lotus uligonosus* (= *major*)), Blackwell switchgrass (*Panicum virgatum*), and narrowleaf Wilmington Bahia (*Paspalum notatum*).

Species not considered excellent but which are stronger than in 1950 are: stoloniferous redtop (*Agrostis alba*), and sand lovegrass (*Eragrostis trichodes*). Weaker species still living include: KR bluestem (*Andropogon ischaemum*), alta fescue (*Festuca elatior arundinacea*), Ky-31 fescue (*Festuca elatior arundinacea*), trefoil (*Lotus corniculatus*), and Ladino clover (*Trifolium repens*).

Fire

Prescribed burning

In shortleaf-loblolly pines.--A project analysis covering investigations in the use of fire to control hardwoods in shortleaf-loblolly pine types in east Texas was completed. Until actual tests determine the efficiency of this technique, it is being used in exploratory fashion on several large management studies. A total of 225 acres was burned in 6 fires in order to improve seedbed conditions for the fall of the bumper 1951 seed crop. Although headfires were used for the most part in late January and March, little immediate damage was apparent, except where the wind died down and allowed heat to rise and scorch the crowns.

A prescribed-burning study installed in the "Big Thicket" in east Texas in 1948 was reburned in March 1951 in an effort to kill new sprouts and to clean up yaupon (*Ilex vomitoria*) and other hardwoods killed in the first burn. Fuel accumulation was reduced and good sprout kill was obtained. The double burn appears to have opened up the dense hardwood understory effectively. It is hoped that if moisture conditions are favorable in 1952, the good shortleaf pine seed year of 1951 may result in considerably better stocking of pine. Analysis is incomplete, however, and observations must be continued for several years before recommendations can be made.

Before planting longleaf.--On the Harrison Experimental Forest in south Mississippi, burning a grass rough before planting longleaf seedlings in February 1949 decreased the severity of brown-spot defoliation three growing seasons later. Since 1949 was a year of relatively light infection on the Harrison Experimental Forest, it is not certain that burning would be as effective just before a year of rapid spread, such as 1950. In March 1950, unsprayed longleaf seedlings had only 3 percent of their needles killed by brown spot. A year later, brown-spot defoliation of unsprayed seedlings was 15 percent on plots burned before planting and 29 percent on unburned plots. By December 1951, this defoliation had increased to 25 percent and 42 percent, although check plots sprayed several times each year with Bordeaux mixture still had only 3 percent needle kill.

In slash and longleaf plantations.--On the Harrison Experimental Forest in south Mississippi, mixed longleaf and slash plantations outplanted in 1941 were subjected to headfires 2,4, and 8 years after planting.

Burning 2- and 4-year-old slash seemed to retard height growth and survival, but burning 8-year-old slash (when it was 23 feet tall) did not seriously affect either. The benefits of early longleaf burns for brown-spot control apparently just about offset the damage to healthy longleaf. Fire did not notably affect the control or incidence of fusiform rust cankers on slash--about 1/3 of the burned and unburned slash pines had cankers in or threatening the stem. Only one longleaf out of 842 had a canker.

Fire resistance of longleaf seedlings

Observations in south Mississippi and in Florida on longleaf seedlings burned in various seasons and at various ages indicate that it is not safe to generalize about damage or benefits to young longleaf from fires, since local sites, weather conditions, and disease situations all influence the net outcome. Data were summarized in an article on page 25 of the January 1951 Journal of Forestry.

Another study in south Mississippi on longleaf seedlings burned at various ages in various ages of rough indicated that the older the seedlings, the better the survival. It was found that 9-month-old seedlings tend to succumb regardless of age of rough. Results were reported on page 739 of the October 1951 Journal of Forestry.

Wildfire mortality among southern pines

Data on fire-caused mortality of pine in national forests in Texas, Louisiana, and Mississippi were reanalyzed to separate out the effects of season and logging slash. As might be expected, logging slash was the cause of most of the mortality amongst trees over

3 inches d.b.h. On the burns that were studied, the logging slash fires killed half the loblolly trees 2 to 8 inches in d.b.h. and about 80 percent of the shortleaf in these sizes. On the other hand, winter headfires on the average killed relatively few southern pines over 3 inches d.b.h. Loblolly, with 22 percent mortality in the 3-inch class, was least fire-resistant. Longleaf, slash, and shortleaf in the 3-inch class had about 4 percent mortality from winter headfires. In pines about 7 inches in d.b.h., mortality fell to 5 percent for loblolly and to about 1 percent for the other species.

These differences are due in part to differences in fuel, but are fairly representative of averages that may be expected in years of nearly average precipitation at the southwest end of the southern pine belt. They are based on tallies of nearly 70,000 living and killed trees in 188 different fires.

Fuel production on the Osceola National Forest

The average amount of fuel less than 1 inch in diameter was sampled for several stand, brush, and rough classes in the Osceola National Forest in Florida. There were 2 more tons of fuel per acre where gallberry and palmetto were present than where they were absent. Detailed weights were reported on page 20 of the July 1951 Fire Control Notes.

Mensuration

Region 8 and the Southern and Southeastern Forest Experiment Stations agreed on a set of southern pine log and tree grades and submitted them to the U. S. Forest Products Laboratory and the Forest Service Log Grade Committee for approval and publication.

"Plotless timber estimates--new, fast, easy" appeared in the January 1952 issue of the Journal of Forestry. The article describes a method for estimating stand basal area per acre quickly and accurately by merely counting trees, and without measuring or estimating tree diameters or distances from the sampling point. It discusses theory and applications of point-sampling (also known as variable plot radius sampling or *winkelzählprobe*), and shows that estimates of volume, stand structure, and stocking are easily obtained. This method should greatly facilitate not only extensive reconnaissance but also the making of rapid decisions for marking for stand improvement, accretion cuttings, and timber harvest.

A shortcut technique needing only simple records of log diameter and length was developed for obtaining felled volume simultaneously in terms of cubic feet and board feet according to various log rules. An account of the technique will be published in Occasional Paper 126, along with a discussion of point-sampling and other cruising and scaling shortcuts.

Occasional Paper 118 discussed the value of low-altitude continuous-strip aerial photography (Sonné photography) in forestry. The value of such photography for direct measurement of tree height and diameter was less than had been hoped, but the technique will be quite useful for species determination, typing, and reproduction surveys.

Growth

A study of growth rates in uniform second-growth stands of longleaf pine of varying densities and varying average sizes was initiated in south Alabama in 1951. Half of the scheduled 75 plots have been measured.

Growth, yield, volume, and lumber grade yield calculations for eastern redcedar in the Ozarks have been completed. Arrangements have been made to obtain data on costs of management and harvesting so that a complete report can be prepared for publication.

Farm Forestry Research

Mississippi

Arizona cypress, eastern redcedar, and loblolly pine were planted in 1951 to determine the cost and returns from growing these species for Christmas trees in north central Mississippi.

First-year survival was generally poor, except that Arizona cypress planted on the Pontotoc Ridge survived 81 percent. The second-best performance was obtained from loblolly pine, which averaged 51 to 59 percent survival on all sites except the Flatwoods. (table 15).

Table 15.--First-year survival of Christmas tree plantings in north-central Mississippi

Date planted (in 1951)	Site	Species	1951 fall survival
			Percent
Jan. 15-25	Flatwoods	Loblolly pine	13
		Eastern redcedar	39
Feb. 27-28	Sand-clay hills	Arizona cypress	49
		Eastern redcedar	25
		Loblolly pine	55
March 1-2	Flatwoods	Arizona cypress	10
		Eastern redcedar	7
		Loblolly pine	59
March 6-8	Pontotoc Ridge	Arizona cypress	81
		Eastern redcedar	45
		Loblolly pine	51

Because the results were poor, this planting will be repeated in 1952.

Methyl bromide was found to be successful for controlling weeds and grasses in loblolly pine seed beds in an experimental nursery.

Reduced funds made it necessary to terminate cooperative farm forestry work in Mississippi at the end of 1951. It is hoped that Mississippi State College will be able to continue long-term studies established under this project.

Alabama

Owing to curtailment of funds, farm forestry research in Alabama was terminated in 1950.

FOREST ECONOMICS

Forest Resources

Tennessee

An inventory of Tennessee's forest resources was completed in late 1950. After more than 150 years of settlement and development, 12.6 million acres, or 47 percent of the State's land, is still in forest growth.

The highest proportion of forest is in the Cumberland Plateau and eastern Highland Rim section. Here the soils are predominantly thin and agriculturally unproductive, and 69 percent of the land is in forest. The rough lands bordering the Tennessee River in the west-central part of the State are next with 62 percent of forest. The valley and mountain section east of the Cumberland Plateau is third with 49 percent. The Central (Nashville) Basin and west Tennessee sections, with deep, fertile soils and predominantly rolling topography, have the smallest proportion of forest, 37 and 30 percent respectively.

Upland hardwood forests occupy two-thirds of the forest land. The State is a transition zone where characteristically southern species meet and intermingle with species whose greatest occurrence is further north. Southern species of oaks and hickories, yellow-poplar, and the gums are mixed with northern oaks, hickories, and sugar maple; on the Cumberland Plateau and Appalachian Mountains the ranges of shortleaf and Virginia pines overlap those of white pine and hemlock; and in the higher parts of the Appalachians, spruce and fir also extend their range southward into Tennessee. Bottomland hardwood forests are important only in the extreme western part of the State.

That Tennessee's forests have long received heavy use is evidenced by their present condition. Only a fourth of the present forest is in saw-timber stands--that is, has a volume of 1,500 board feet or more per acre in merchantable sawlog-size trees. Some 60 percent is in cordwood stands; and most of the remaining 15 percent is seedlings and saplings.

Sawlog volume totals 16.2 billion board feet, International 1/4-inch rule, of which four-fifths is hardwoods and one-fifth softwoods. Oaks account for 54 percent of the hardwood volume, hickories for 12 percent, yellow-poplar for 9 percent, and other hardwoods for the remaining 25 percent. Southern pines make up 71 percent of the softwood volume.

Half of the softwood sawlog volume is in trees less than 13 inches in d.b.h., and six-tenths of the hardwood sawlog volume is in trees less than 17 inches in diameter.

On a preliminary analysis, it was found that farmers own 48 percent of Tennessee's commercial forest land. Businessmen, professional workers, wage earners, and housewives together own another 30 percent. Forest industries hold 6 percent; mining companies, banks, land speculators, and the like, 7 percent; and public agencies, including the U. S. Forest Service, 9 percent.

Arkansas

Forest Survey field work for Arkansas is now complete. The survey of the last region, the Ouachita Mountains, was finished in April.

A survey of current logging operations in the State was also made during the year. The results were published as Forest Survey Release 67. The survey found that both pulpwood and sawlog operators take an average of two-thirds of the pine growing stock from stands in which they cut. Pine trees cut for sawlogs in southwest Arkansas average bigger than in the mountain regions, but stands are cut more heavily in the mountains. Large sawmill operators leave a heavier stand after logging and take more of their cut from big trees than do the small mill operators.

Hardwood logging does not cut into stand volume so heavily as pine; volume removed ranges from one-fifth of the growing stock for hewn ties to half for veneer and sawlogs. Higher grade hardwood timber is cut more severely than lower grades. Hardwood timber cut in southwest Arkansas and the Delta is usually bigger than in the mountain regions, but the proportion of stand left after cutting is about the same everywhere. The contrast is less than in pine, but large hardwood sawmill operations also take bigger trees than small mill operations and leave more of the initial stand after logging.

Alabama

A reinventory of Alabama forest resources was begun in May. By the end of 1951, field work had been completed in north Alabama (Unit 6) and was almost three-fourths complete in west-central Alabama (Unit 4). The previous survey of Alabama was made between 1934 and 1936.

Mississippi

The comprehensive report, "Mississippi's forest resources and industries", was published by the U. S. Department of Agriculture as Forest Resource Report No. 4.

Land use in southwest Louisiana

A bulletin, "Planted pines and cattle grazing--a profitable use of southwest Louisiana's cut-over pine land", was published by the Louisiana Forestry Commission. The bulletin is a joint effort of the Station's divisions of Range Research and Forest Economics. It surveys present land-management practices in the area, suggests better management practices for coordinating timber and livestock use, and estimates the costs and possible returns to large landowners as well as to farmers from such management.

The total net income from sawlog and pulpwood stumpage (above all costs except the investment in land) is estimated at $1,026 per acre for a 65-year rotation, or about $15.80 per acre per year. Improved cattle management and close correlation of grazing on forest range and improved pasture would increase net returns. Conservatively grazed pine plantations could furnish two-thirds of the feed requirements, thereby netting $1.00 or more per acre per year of range income during the first 5 to 10 years after planting. Range income would decrease to $0.35 net income per acre per year as the planted pines began to grow and smother the grass, but toward the end of the rotation periodic thinnings and occasional prescribed burns would raise it to $0.40 or $0.50.

Atlas of forest-economic information for the South

Additional tables and some revised tables based on new data were published for insertion in the "Atlas of forest-economic information for the South". The Atlas is a joint project of the Southern and Southeastern Forest Experimental Stations.

Forest Industry

Pulpwood production in 1950

Pulpwood production in the Station's territory totalled 5,579,000 cords in 1950, a 27-percent increase over 1949 and 11 percent over the previous high year of 1948. Pine accounted for 90 percent of the 1950 production, or 5,031,000 cords; hardwood for 10 percent, or 548,000 cords (table 16).

For the entire South, production reached an all-time high of nearly 12½ million cords, thus topping by over a million cords the previous record year of 1948. The total U. S. cut in 1950 was about 21 million cords. Georgia, with a harvest of 2,200,000 cords, was the leading southern producer. Mississippi ranked second with 1,700,000 cords.

Detailed information on the South's pulpwood crop was published in Forest Survey Release 69.

Table 16.--Pulpwood production in Southern Station territory, 1950

State	Total	Softwood	Hardwood	Percent change from 1949
	- - - Thousand cords		- - - -	
Alabama	1,321	1,313	8	+ 45
Arkansas	604	543	61	+ 8
Louisiana	883	825	58	+ 16
Mississippi	1,666	1,389	277	+ 43
Oklahoma	39	39	...	+ 2
Tennessee	144	46	98	- 9
Texas	922	876	46	+ 17
Total	5,579	5,031	548	+ 27
Entire South	12,436	11,171	1,265	+ 25

Lumber production by species

A series of maps showing distribution of lumber production by species was published as Forest Survey Release 68.

In 1947 (the latest year for which complete statistics are available), the seven States of Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas accounted for 22 percent of U. S. total lumber production--18 percent of the softwood and 37 percent of the hardwood lumber. The mills in these States cut 72 percent of the sweetgum lumber, 58 percent of the black and tupelo gum, 53 percent of the southern yellow pine, and 40 percent of the oak and cypress. They were also a major source for ash, beech, cottonwood, elm, hackberry, hickory, magnolia, pecan, persimmon, sycamore, walnut, willow, and yellow-poplar.

Pulpwood production costs

The costs of producing pine pulpwood in southeastern Arkansas have more than tripled in the last 10 years. This is shown by studies, made in 1940, 1945, and 1950, to determine changes in production methods, equipment, and costs.

These studies indicate that there has been a definite trend toward the use of more mechanical equipment. Except for small trees, on which the one-man bow saw is cheapest, chain saws have replaced 2-man crosscut saws in felling and bucking. Tractors have largely supplanted horses for bunching the wood. Pallet systems and other loading devices are gradually replacing hand loading, and larger trucks are being used.

Pulpwood contractors and cutters once thought an operation unprofitable unless the cut per acre was at least two cords. They also considered it generally unprofitable to cut pulpwood from tops of saw-timber trees. In 1950, however, the average production in the territory studied--chiefly on large holdings--was approximately one cord per acre, and at least 50 percent of the volume came from the tops of sawlog trees.

In 1940 the cost of cutting, bunching, loading, and hauling the wood was $3.45 per standard cord for an average 8-mile haul. In 1945 the cost was $7.23. In 1950 the average cost had risen to $11.14 per standard cord, but the average load was hauled somewhat farther.

Over the last 10 years, felling and bucking costs have gone up 198 percent. The cost of bunching, loading, unloading, and delay has risen 269 percent, and hauling cost is up 227 percent. The total average cost of delivering wood today is 223 percent more than it was 10 years ago. Results of the 1950 study are detailed in Occasional Paper 121.

Timber Marketing

Log and bolt market survey

Sixty-eight wood-using plants, representing all types in the area around Birmingham, Alabama, were visited during a study of current utilization practices.

Of the pine users, the small sawmills and the medium sawmills each cut about two-fifths of the 300 million board feet of pine lumber produced in north-central Alabama in 1950. Large sawmills and mine product mills together accounted for less than one-fifth of the total. Slack cooperage plants consumed an additional 25 million board feet of pine.

The large sawmills and the mine product mills were getting the largest logs. About 60 percent of their pine lumber output came from logs over 10 inches in diameter. Small and medium mills cut only 30 percent of their volume from logs of these sizes.

The best grades of pine logs were usually found where the largest logs were cut. About half of the log volume at the large sawmills and mine product mills was of grades 1 and 2. About 40 percent of the log volume at slack cooperage plants was of this quality, and only about 35 percent of the volume at small and medium sawmills.

Among hardwood products, the largest items were lumber and ties, of which about 90 million board feet were cut in 1950. Only about 6 million feet of face veneer logs, less than one million of white oak stave logs, and 1/2 million feet of basket veneer logs were cut.

Over 90 percent of the log volume at face veneer and tight cooperage plants was in logs 13 inches in diameter or larger. About 70 percent of the production from large sawmills also came from these larger logs; but about two-thirds of the hardwood output from mine product mills and well over two-thirds of the hardwood lumber from medium sawmills was produced from logs less than 13 inches in diameter.

Face veneer plants had the best logs, but large sawmills and basket veneer plants also had logs of fair grade. Only 13 percent of the hardwood cut by the medium mills and 24 percent of that cut by mine product mills came from factory grade 1 and 2 logs; about half of the log volume on the decks of these mills was of the lowest grade or cull. Over 70 percent of the hardwood mine props were made from what is ordinarily considered cull material.

The study indicated that forest landowners have a good general market for pine of all sizes and grades, and at least a periodic and limited market for their low-grade hardwood trees. It also showed that 30 percent of the volume used by basket veneer manufacturers was of face veneer quality and that some mine product mills were cutting logs of grade 1 and grade 2 quality into products that could have been made from lower grade hardwood material. Since high-grade timber is becoming increasingly difficult to find, wood-using industries may see in the survey some possibilities of trading raw material of one quality for another better suited to their product.

Marketing problems in northeast Mississippi

In cooperation with the Mississippi Agricultural Experiment Station, a study was made of the timber marketing problems in a 17-county area of northeastern Mississippi. Field work was completed, data analyzed, and the first draft of a report prepared.

Market activity, as described by individuals and agencies interviewed, was generally brisk during the period covered (1937-1950), and thus afforded opportunity to study a variety of marketing methods and practices. Marketing problems in the area stem from difficulties in the handling and selling of the small volume of timber that the average woodland holding now produces. Small volumes keep the landowner from developing interest and ability in growing and selling timber, and hamper him in channeling material into its highest use, financing his operations, and taking full advantage of the strong competition for stumpage and wood products. The buyer or user of timber, in turn, lacks an adequate and economic supply of wood.

Since the area is critically short of good timber, the most urgent need is for vastly improved forest management. Marketing difficulties would also be reduced if both buyers and sellers knew more about estimating, measuring, sorting, and grading timber. Cooperatives or integrated purchasing organizations that would perform some or all of these functions should benefit both landowner and timber buyer. It would be worthwhile, also, to adapt present systems of forest management to the needs of small landowners with limited capital, to determine the optimum or desirable minimum size of family farm forest, and to investigate means of extending credit for the purchase or improvement of woodlands.

Economics of Forest Management

Guides to profitable forest management

"Cutting for profit in southern pine woodlands" was published as Farmers' Bulletin 2027 of the U. S. Department of Agriculture. It tells how to manage the farm woodland for steady cash income each year and how to improve the average farm forest and make it pay a great deal more than it does now. It tells what to cut, how much, how often, how to harvest and market products under a sales contract, how to protect the forest, and how to keep records of costs and incomes.

"Financial maturity of bottomland red oaks and sweetgum," Occasional Paper 117, offers a guide to owners for deciding when to cut bottomland hardwoods in order to make the most money from growing and harvesting them. The heart of the paper is a method of determining when a tree is financially mature--that is, when its rate of value-increase from volume growth and quality improvement falls below that which can be obtained from alternative investments of similar risk. To aid woodsmen in judging growth rates quickly and easily, the paper describes and illustrates a system of appraising the vigor of trees from their bark and crowns. It also presents a set of simplified marking guides. The paper concludes that when the desired rate of return from timber is 4 percent, fast-growing bottomland hardwoods can profitably be held until they reach 30 inches in d.b.h. Slower growing trees may reach financial maturity when they are as small as 21 inches d.b.h.

A study of financial maturity in southern upland hardwoods was also completed. While the study was made with special reference to the forests around Birmingham, Alabama, it should also prove widely applicable in other parts of the South. The data are restricted to red oaks, white oaks, and yellow-poplar, and to the chief products into which these trees are cut: standard factory lumber, cross ties, and--around Birmingham--mine props.

The report on the study defines and illustrates three vigor classes and tabulates gross and net tree values, production costs, and rate of tree-value increases when trees of the different vigor classes are utilized for various products. Finally, the data have been reduced to a set of simplified marking guides for use in the woods. These guides show that where the trees are of saw-timber caliber, upland red oaks of high vigor can be grown to about 28 inches d.b.h., yellow-poplar to about 26 inches, and white oaks to about 24 inches if an alternative rate of 4 percent is satisfactory to the owner. The results of the study will be published as Occasional Paper 125, "Marking guides for oaks and yellow-poplar in the southern uplands."

A study of relative productivity and returns in converting two forties of second-growth loblolly-shortleaf pine to even-aged management and two similar forties to all-aged management was continued in central Mississippi in cooperation with the International Paper Company. In 1950, when the study was initiated, the experimental areas had between 2 and 3 M board feet (Doyle) of saw timber. Some trees were 18 or 20 inches in d.b.h. and there was an understory of smaller trees, including an abundance of reproduction.

Stand improvement, three years before the study was started, removed the lower-quality pines and all merchantable and unmerchantable hardwoods. On two forties half of the present stands were converted to even-aged stands of advance reproduction by clear-cutting the overstory on strips 5 chains in width. Poles, sawlogs, and pulpwood with a stumpage value per acre of $93 were cut. The timber that was removed was growing fast enough so that if it had been left another 5 years its saw-timber volume would have increased 78 percent, or 12 percent annually compounded. Value increase would have been still greater. The remaining strips will be cut after ten years, when the present reproduction will be 13 years of age and reasonably safe from fire. On the two forties set aside for all-aged management, the first cut after improvement will be made in 1955. Other cuts will come at 5-year intervals thereafter.

Returns from well-managed commercial forests

At the Branch at Brewton, Alabama, a 645-acre tract of second-growth longleaf pine has been under intensive management for three years. Three improvement cuts on the more heavily stocked portions have produced 89,000 board feet (Doyle) of sawlogs, 363 poles, and over 400 standard cords of pulpwood, worth $9,566 delivered to market. The average annual delivered value of products for the three years (1949-1951) was thus $4.94 per acre. If sold as stumpage, the timber would have been worth $1.90 per acre per year.

The total cost of logging has been $3.04 per acre; this included a margin for profit and risk of 64 cents per acre. Since the cuts removed less than 3/4 of the total volume growth during these three years, a stumpage value of about 70 cents per acre was added annually to the growing stock. The average annual cost per acre of intensive management was about 37 cents. It included the following items:

General property tax	$ 0.10
Fire protection	.05
Marking timber to cut	.08
Hardwood control	.01
Prescribed burning	.03
Management plan and cruise	.10
Total per acre per year	$ 0.37

If the owner had made his own plan and cruise, he would have saved the cash cost of 10 cents per acre for these items. If he had done his own logging he would also have earned the 64 cents allowed for profit and risk in the logging costs.

Returns from well-managed small tracts

Studies of costs and returns from small, intensively managed forests were continued in 1951 on the experimental forests at eight branch stations. The purpose is to determine the financial possibilities of managing and harvesting timber on farm forests and other small tracts. The products are usually cut annually and piled at the roadside. Then, in cooperation with the Extension Service or other agencies, a field day is held so that farmers can see the products and the woods from which they were taken. Returns, costs of cutting and time required, and methods of marking and harvesting timber are explained during tours of the woods. Often several hundred visitors attend these field days.

Significant results from the various branches are recorded below. They include records of experience and of costs and returns in the several timber types of the lower South.

At the Alexandria Branch, in the cut-over longleaf region of Louisiana, a severe ice storm in early 1951 made necessary a salvage cut of damaged trees (plantations of all four southern pines) for pulpwood on an experimental area of 550 acres. This operation yielded 611 cords at $3.40 per cord stumpage, a total of $2,077. An additional income of $649 from 515 tons of stumpwood increased the total average stumpage income to $4.96 per acre. The continuing purpose of this study is to determine costs and returns and to demonstrate methods of managing cut-over land for timber and cattle production combined. Cattle are being grazed on the area. Future incomes from the cattle and the money from salvaged timber will be used to plant open parts of the tract with slash and loblolly pine.

At the Birmingham Branch, the fourth annual cut on a moderately stocked compartment of 38 acres under intensive management removed 1,285 board feet (International 1/4-inch rule) of sawlogs and 1,462 cubic feet of coal mine props. Virginia pine and oak made up most of the volume of these products, which had a gross delivered value of $329, or $8.66 per acre. The timber was of such low grade that its value as stumpage would have been only $1.49 per acre. When this stumpage value, plus cutting and hauling costs of 85 cents, is deducted from the delivered value of the products, a net return per acre of $6.32 remains. Since 6.5 man-hours per acre were spent in logging, the rate earned per man-hour in cutting and hauling products was 97 cents.

The fourth cut on a poorly-stocked unit of 36 acres removed 675 cubic feet of hardwood mine props and 200 board feet of shortleaf pine that was affected with littleleaf disease. The gross delivered value of these products was $131, or $3.65 per acre. When per-acre stumpage values of 19 cents and out-of-pocket logging costs of 40 cents were deducted, the net return was $3.06 per acre. Logging required 3.2 man-hours per acre. The rate earned per man-hour in cutting and hauling products was therefore 96 cents. Less than a quarter of an hour per acre was required to mark the trees and to scale the products on both the moderately stocked and the poorly stocked units.

At the Brewton Branch in south Alabama, intensive forestry has been practiced for three years in second-growth longleaf pine on one "poor" and one "good" forty-acre tract. On the good forty, old-growth and limby second-growth longleaf pines have been turpentined for two years and then cut to improve the stand. On the poor forty the problem is to obtain an annual income from the present poorly stocked stand while a new stand is being grown to merchantable size. Hence the large longleaf pines now present are being turpentined by the method of working a front face for five years and then a back face for another five years. The returns from the three years of operation on the two forties are shown in table 17.

For the good forty 10 man-hours, and for the poor forty 5½ man-hours per acre were required annually for harvesting. The out-of-pocket costs for rental of tractor and power saw, for supplies, and for contracting hauling of logs and pulpwood total $3.17 per acre per year for the good forty and $0.56 for the poor forty. On the good forty, annual costs per acre for taxes, marking paint, chemicals for poisoning hardwoods, and other materials and equipment used in management have averaged about 12 cents; and less than a quarter-hour of labor per acre has been expended annually in marking trees for cutting and on stand improvement. On the poor forty the annual costs have averaged 24 cents per acre, and 6/10 of an hour per acre has been expended annually for marking, planting, and prescribed burning.

Table 17.--Volume and value of products harvested in 3 years from two intensively managed farm forest tracts in south Alabama

Product	Volume	Value	
		On stump	Delivered
		Dollars	
	GOOD TRACT (40 acres)		
Sawlogs	13,999 bd. ft. (Doyle)	300.38	626.44
Gum	18.93 standard barrels	104.20	416.82
Pulpwood	25.27 standard cords	72.30	277.74
Fuel wood	24.19 standard cords	.00	193.52
Posts	312 pieces	17.57	52.73
All products		494.45	1,567.25
Average per acre per year		4.12	13.06
	POOR TRACT (41 acres)		
Gum	14.45 standard barrels	79.27	317.07
Fuel wood	9.00 standard cords	.00	72.00
Posts	251 pieces	13.58	40.73
All products		92.85	429.80
Average per acre per year		.75	3.49

At the Crossett Branch in south Arkansas, the "good farm forestry forty"--a second-growth stand of loblolly and shortleaf pine--has now been under intensive management for fourteen years. During this period 174,500 board feet (Doyle) of logs, 312 cords of pulpwood, 228 cords of fuel wood, and 418 fence posts have been harvested.

These products had a stumpage value of $3,442, a roadside value of $6,441, and a market value of $9,439. The fourteenth annual cut removed 13,700 board feet of logs and 17.75 cords of pulpwood from the forty, or an average of 343 board feet of logs and 0.44 cord of pulpwood per acre. These products had a total stumpage value of $590, a roadside value of $793, and a market value of

$997. Their per-acre value was $14.76 on the stump, $19.84 at the roadside, and $24.91 delivered to market.

In 1951 a total of approximately 6½ man-hours of labor per acre was required to cut and deliver the logs and pulpwood. By harvesting the timber himself instead of selling it as stumpage, an owner would have realized $10.15 per acre ($24.91 delivered less $14.76 stumpage) for 6½ hours of labor. His outlay--for operating and maintaining equipment, and supplies, tools, and other items--would have been $2.20 per acre, so he would have netted $7.95 per acre, or $1.22 per hour of his labor.

Since stocking on this forty is good, the annual cuts have been held approximately equal to the annual growth in cubic volume. Nevertheless, there has been a big increase in the pine sawlog volume. Removing the low-grade hardwoods and the poorer and more mature pines has increased the yearly volume growth (table 18) and improved the quality.

Table 18.--Volumes, measured before cutting for the years indicated, for the Crossett "good farm forestry forty"

Year	Volume of growing stock			Average annual volume growth, trees 12 inches d.b.h. and larger
	Trees 4 inches d.b.h. and larger		Trees 12 inches d.b.h. and larger	
	Cubic feet	Standard cords	Board feet (Doyle)	Board feet (Doyle)
1937	1,793	21.2	5,074	
1941	1,872	22.1	5,766	244
1946	1,740	20.5	6,454	372
1951	1,968	23.2	8,295	596

In the last 5 years, cubic-foot growth for the stand that is 4 inches and larger in d.b.h. has been equal to an annual 5.6 percent simple interest. For the sawlog portion of the stand, annual growth in board feet has been equal to 9.2 percent simple interest.

During the 14 years of management, only one non-commercial, non-revenue timber stand improvement job has been made on the good forty. This cost 2.6 man-hours, about $2.08 per acre, and freed the pine from serious hardwood competition. A recent inventory shows that 91 percent of the area is stocked with pine seedlings, saplings, poles, or sawlog trees. About two man-days for the forty, or less than 1/2 hour per acre annually, is required to mark trees to be cut and to scale the products harvested.

In 1937, a tract of 34 acres, the poorest stand of timber on the Crossett Experimental Forest, was selected for a demonstration of the possibilities of managing seriously depleted farm forests. Since then, 13 light annual improvement cuts have removed the poor quality pines and hardwoods. All of these cuts more than paid expenses. One non-revenue improvement job cost $1.92 per acre to girdle or poison worthless hardwoods. Today pine seedlings, saplings, poles, or sawlog trees occupy over 90 percent of the growing space on this "poor forty". The annual volume growth of trees of all sizes is more than 1¼ cords per acre, and the annual growth of trees of saw-timber size is nearly 400 board feet (Doyle) per acre. The thirteenth cut removed 8,600 board feet of sawlogs and 4.7 cords of pulpwood; this volume equaled about half of the growth produced by the stand during the year. The gross stumpage value of this cut was $357, or $10.48 per acre. The value delivered to the mill or market was $543, or $16 per acre.

At the East Texas Branch, a 67-acre farm forest is divided into 5 compartments. In 1951 the fourth compartment of 13 acres was covered by an improvement cut that removed 5,470 board feet (Doyle) of shortleaf and loblolly pine, 830 board feet of white oak, and 3,650 board feet of red oak. About a fourth of the pine and a fifth of the hardwood saw-timber growing-stock volume was cut. An additional 2,240 board feet of pine that had been killed by drouth and insects was salvaged from other compartments. The return from the sale of all sawlog stumpage was $246. At current local prices the logs had a roadside value of $338 and a delivered value of $477. When averaged for the entire 67 acres, the per-acre return was $3.67 for stumpage, $5.04 for products at the roadside, and $7.12 delivered to the mill.

On fourteen acres of the farm forest, low-grade hardwoods that were interfering with pine were girdled or poisoned with Ammate. Ammate was used only on trees small enough to cut down or on those difficult to girdle. The average tree girdled was 9.5 inches d.b.h. A total of 412 stems (basal area of 202 square feet) was treated at a total cost of $17.44 for labor and $0.46 for Ammate. Thus, on the average acre, approximately 30 trees were treated for $1.28.

Prescribed burns have been made on 22 acres of the farm forest where dense underbrush and small, low-grade hardwoods interfere with the establishment of pine reproduction. Head fires were necessary to achieve results. Burning in low areas along a creek gave variable results, but in upland areas with dry litter, fire killed most of the hardwoods up to 1½ inches in diameter (measured 6 inches above ground) and opened up the understory satisfactorily. Even though a creek and the road system were used as natural fire barriers, an average of about 0.7 man-hour per acre was needed for fire-line construction, burning, and patrol on these small areas.

At the Gulfcoast Branch in south Mississippi, the fourth annual cut on the four second-growth longleaf-slash pine "farm forestry forties" removed a total of 9,450 board feet (Doyle) of pine sawlogs, worth $187.80 on the stump or $313 delivered at the roadside. Besides the sawlogs, 2.86 standard barrels of gum were harvested. The gum returned $19.82 in PMA payments and from leased faces. Delivered at the roadside, it was worth $57.81. Only the upland portions of the four forties, totaling 141 acres, were cut over. The per-acre gross income was $1.47, of which $1.33 was from sawlog stumpage and $0.14 from PMA payments and leased faces. The roadside value was $2.63 per acre, $2.22 for logs and $0.41 for gum. Producing and delivering products to the roadside required 0.7 man-hour per acre and earned $1.16 over stumpage values, or at the rate of $1.65 per man-hour. Out-of-pocket costs were $0.08 per acre. On the best of the four forties, the annual gross per-acre income from stumpage was $2.80 and from leased faces $0.31; at the roadside the values were $4.66 for sawlogs and $0.81 for gum. On all four forties, however, stocking is still far below normal.

During the year, 20 acres on one forty and 8 acres on another were prescribe-burned for brown-spot control. The cost of plowing fire lines was $9, and 18½ man-hours were required to do the burning. Seven hundred longleaf pine seedlings were planted under large oaks in one forty where natural regeneration had failed. Seedlings are supplied free to farmers, but a total of 7 man-hours was required for the planting.

At the Central Ozarks Branch in northern Arkansas, the first improvement cuts on four small management units of upland hardwoods, pine, and cedar are now being made. Records of costs and returns of management and of costs of harvesting are being kept.

In upland hardwoods and pine at the Tallahatchie Branch in northern Mississippi, three forties are managed with different degrees of intensity. Progress has been slow because it has been impossible to sell the poor quality and low volume of timber that needs to be removed. Underplanting of pine and cedar and girdling of the over-story of poor hardwoods has been successful.

Special Studies for National Defense

Analyses of timber supply were made in connection with 27 applications for accelerated tax amortization. Twenty-five of the applications were from pulp companies and two from veneer manufacturers. To date, approval of 12 applications and issuance of certificates of necessity by the National Production Authority has been announced. Additional pulping capacity to be built under these certificates represents a 21-percent increase over existing capacity in the Station territory.

The Station participated in a national survey, conducted for the National Production Authority by the Forest Service, to determine the use of equipment, manpower, and supplies by the various forest products industries in 1950. The object of the survey was to obtain a basis for estimating war-time needs in logging. In Southern Station territory, 294 sample plants and a much larger number of log suppliers were visited to obtain the necessary information. By their excellent cooperation in furnishing information, the industries aided greatly in bringing off this complex and difficult job.

RANGE RESEARCH

Grazing Management

Forest grazing leases

In recent years the greatly increased value of cattle has caused a growing demand for fenced forest range in the Deep South. Livestock owners are recognizing that fenced range is necessary to carry out herd improvement and good feeding practices. Also, new livestock control laws that call for removal of domestic animals from unfenced range have been passed in Alabama and Florida, and one is under consideration in Louisiana.

Both forest owners and cattle farmers have been inquiring as to the terms of a mutually satisfactory grazing lease providing for fencing of forest range. A study of several going leases on forest ranges in Louisiana and east Texas indicated that the following points should be specified: (1) How long the lease will run. (2) The acreage, and a legal description of the land. (3) Ownership of the livestock, and whether grazing rights are to be exclusive or shared with others. (4) Who will finance, build, maintain, and own the fence, and how the cost will be amortized. (5) Kind of livestock. (6) Number of animals permitted. (7) Grazing season. (8) Grazing fee. (9) Rights included in the lease. (10) Liability for injury or death of livestock. (11) Prevention of damage to forest. (12) Provision for cancellation of lease.

Most of these points are covered in several new leases being negotiated between forest landowners and cooperative grazing associations in south Alabama and west Florida. The grazing associations are a recent development--a consequence of the new Alabama livestock law, which takes effect June 1, 1952.

Range forage inventories

At the request of Region 8 and the Texas National Forests, simplified instructions for forage inventories were prepared. They are based on results and experience in measuring forage production and grazing cattle for the past 7 years at the Alexandria and Gulfcoast branches. The method, which was tested on two allotments on the Texas National Forests, requires that the forage be clipped and weighed or estimated on small plots 9.6 square feet in size. The forage weight is then converted to pounds per acre, something everyone can readily understand. This in turn is converted to estimated capacity. The method needs further development and simplification for administrative use. However, it gave a good preliminary estimate of available forage and grazing capacity in both longleaf and shortleaf-loblolly pine types, in spite of the fact that 1951 was a drouth year in east Texas.

Forage production in managed longleaf forests

Data in south Alabama in 1948 and 1949 were analyzed to determine the relationship between herbage production and the density of the tree stand, the amount of litter on the ground, and the type of soil. By far the most forage is furnished by the uplands, where the understory vegetation is predominantly little bluestems, with about 15 percent each in forbs and browse species. On upland and bottomland plots combined, grass and forb herbage production averaged about 1,000 pounds (air-dry) per acre in treeless openings. Production dropped rapidly to 500 pounds per acre as the density of tree stands increased to 75 square feet of basal area. Above this tree stand density, herbage production dropped off less rapidly. This may have been due to the fact that the plots with the greater basal areas also had the better soils.

Herbage production was even more closely related to the amount of leaves and pine needles on the ground. From 1,000 pounds per acre where no litter was present, herbage production fell steadily to about 200 pounds per acre where the litter was over 8,000 pounds per acre.

The relationship between herbage production and upland soil types was also striking. When production on different soils was adjusted to the average weight of litter, it was found that soils with a heavy subsoil (sandy clay or heavier) produced an average of 860 pounds of herbage per acre, whereas soils with a loamy subsoil produced 680 pounds per acre. Pure deep sands produced only 470 pounds per acre.

Seasonal grazing on forest range

The grazing studies on the McNeill Experimental Forest in south Mississippi continued to show that there is commercial grazing under moderate- to well-stocked stands of 40-year-old longleaf pine.

Spring grazing conditions were slightly poorer in 1951 than in 1950, but late summer grazing was better. Native yearling steers provided by the Mississippi Agricultural Experiment Station were turned into the four 160-acre forest range pastures on April 18, 1951. On August 6, the 32 steers from the two short-season pastures were moved to a Vasey grass pasture until October 5, when they were sold for $22.38 per cwt. The average gain per head on the forest range was 74 pounds, or 8 pounds less than in 1950; average daily gains per head were 0.66 pound in 1951 and 0.78 in 1950.

The 16 steers on the two long-season pastures were removed on October 29 and sold for $23.12 per cwt. Their average weight gain, 126 pounds, was almost the same as in the previous year. Average daily gains to the end of July were about 0.90 pound in 1950 and 0.75 in 1951. However, in 1950, gains from August 1 to mid-November were only 0.25 pound per day compared with 0.50 pound per day in 1951. Greater rainfall improved late-season grass growth in 1951.

Gross weight gains were greater in 1951 on all pastures because more steers were grazed. In 1950, the total for four pastures was 36 steers gaining a total of 3,730 pounds, or 5.8 pounds per acre worth $1.37 at 1950 selling prices. In 1951, with 48 steers, the total gain was 4,397 pounds, or 6.8 pounds per acre worth $1.55.

With the heavier stocking of cattle in 1951, forage utilization averaged 17 percent by late July and 25 percent by November. In 1950, average utilization ranged from about 10 to 12 percent. The increased stocking in 1951 also resulted in better use of the range and reduced the forest fuel more effectively. Little bluestems made up 75 to 87 percent of the forage consumed. Other grasses contributed most of the remainder of the diet. Forbs and browse combined averaged only 3 to 9 percent of the diet, and were grazed mostly in the spring.

Three pastures, each containing about 575 acres of very open, cut-over longleaf pine range, were fenced in 1951 on the new Longleaf Tract of the Palustris Experimental Forest, in central Louisiana. Permitted grazing started on October 1 with 109 cows and heifers owned by five local cattle producers. This new study will follow up on some of the practical problems of season and intensity of grazing and herd management brought out by Louisiana Agricultural Experiment Station Bulletin 452, which was published in 1951.

A preliminary inventory of the three experimental pastures showed that the bluestem forage type on this area is about 35 percent slender bluestem (Andropogon tener) and 20 percent pinehill bluestem (A. divergens). This range has much more slender bluestem than experimental pastures used in previous studies. Slender bluestem matures and deteriorates several weeks earlier than other bluestems. However, it is dominant on many areas in southwest Louisiana. A widely applicable system of seasonal management that utilizes this rather low-quality slender-bluestem range and gives high beef production is badly needed.

Poisonous plants

As in 1950, cattle in south Alabama grazed crowpoison or stagger-grass (Amianthium muscaetoxicum) heavily from its first appearance until it bloomed in late April. The 1949-50 winter was very mild, and the winter of 1950-51 was one of the most severe on record. However, no reported cases of poisoning were traced to crowpoison in either year. Possibly the poison does not develop in quantity in the plant until after heavy grazing stops. It may also be that some of the early spring cattle losses attributed to malnutrition are partly due to poisoning.

Definite diagnoses of plant poisoning were made in two cases in 1951. In one, cattle had been confined in a small area with insufficient feed and had eaten bracken fern when more palatable forage was gone. The second case was not so clear-cut, but Carolina jessamine (Gelsemium sempervirens) may have been responsible for the death of several cows.

Grazing damage to pine reproduction

In 1949, some newly established slash pine plantations in La Salle Parish, in central Louisiana, were grazed by cattle. One-third of the trees were browsed, and the damage appeared serious. However, in 1951, after three growing seasons, the damaged seedlings had essentially recovered. On sample plots the grazed trees averaged 70 percent survival and 30 inches in height, while the ungrazed trees averaged 61 percent survival and 40 inches height. Grazing reduced the height growth but did not cause seedling mortality. The superior survival of grazed trees is not regarded as statistically significant, although reduced foliage may have aided some browsed trees to survive dry spells. The plantations were not fenced and have been grazed closely by cattle each season, but measurable damage occurred only in 1949, a winter when green grass was very scarce.

This and related studies indicate beyond doubt that slash and longleaf pine plantation areas can be grazed by cattle the first season after planting with little or no damage, if the cattle are managed properly. The most effective measures are to exclude the cattle from December to April and to regulate their numbers so that no more than half of the grass is grazed each year.

In 1951, about 15 percent of the trees in these La Salle Parish plantations were damaged by hogs; and 85 percent of the damaged trees died during the dry summer. It seems to take about three years for slash pine roots to grow big enough to attract hogs.

A 20-acre block of cut-over longleaf pine land was burned, hog-fenced, and planted with longleaf and slash seedlings in January 1951. Cross fences were established so that parts of the plantation can be opened to grazing by a known number of woods hogs each season for several years. About 10 acres of creek bottom hardwoods were included in the fenced area. For the 4-1/2 months from February thru mid-June, this creek bottom, along with 2.6 acres each of planted slash and longleaf pine, was stocked with an average of 2 woods hogs and 6 pigs. Hardly any hog damage to the planted pines was found during this spring period--only three longleaf pines and one slash pine were uprooted. This unexpected lack of damage is puzzling. However, hogs seldom root slash during the first season, and the longleaf seedlings were unusually small.

An electrical fence, with two charged wires 6 and 16 inches above the ground, was constructed across part of the planted area. Weeds and grass that would have grounded the charged wires were controlled by spraying a two-foot strip under the fence with a chemical weed killer in March. This fence was an effective barrier to the mature hogs--once shocked, they would not get closer than two feet of the fence even for shelled corn. However, the hungry little pigs would reach under the wire to eat the shelled corn, and then squeal each time the electrical current hit them. Effective use of electrical fences for hog control probably depends first on getting the hogs educated and then on keeping the fence always in first-class working order.

Control of Undesirable Hardwoods

In central Louisiana, reexamination in 1951 of hardwood-control plots treated in May 1950 verifies preliminary results reported last year. A 4-percent solution of 2,4-D and 2,4,5-T in fuel oil applied to blackjack and post oaks killed practically all tree crowns and roots. Less than 10 percent of the treated trees sprouted at the base. Frill treatments were most effective, followed closely by application to fresh stumps, spraying of the lower trunk, and injection with the Cornell tool. The most lethal formulations used in the 1950 tests were butyl ester of 2,4-D, isopropyl ester of 2,4-D, and butyl ester of 2,4,5-T. They proved most effective in 1951 also, when tests were expanded to include all four seasons and concentrations of two, three, and four percent.

Preliminary results from the winter and spring 1951 treatments showed 100 percent kill of tree crowns by all chemicals applied in frills. Basal sprouting was negligible from the trees poisoned in spring, but 30 percent or more of the winter-treated trees sprouted. The trunk spray and Cornell tool methods were slightly less effective than frill applications, but they were less hazardous because axes are not necessary. A 3-percent solution of 2,4,5-T sprayed on the lower 16 inches of tree trunks proved effective, but the total cost is about 50 percent higher than applying 2,4-D or Ammate in frills. Ammate, which was used for comparison in all these tests, is still unsurpassed for yearlong use, but 2,4-D, at about the same cost, is very effective for frill treatments in spring.

Artificial Revegetation

Establishing and grazing firebreaks

Fertilized and seeded firebreak blocks established in central Louisiana in the spring of 1950 were stocked with dairy cows again in 1951. The 2.5-acre area provided nutritious grazing from April to October, except for a few weeks in hot, dry periods. Total grazing amounted to 366 cow-days in 1951; this is equivalent to 146 cow-days or 4.9 cow-months per acre, a little more than in 1950.

Further evaluation of individual treatments showed that the cheapest method for establishing grazed firebreaks on this forest range is to burn the grass and litter in winter, and in early spring to spread 500 pounds of basic slag and sow 3 pounds of carpetgrass plus 10 pounds of common lespedeza per acre. In some cases, the land has to be cleared of trees and brush first. Close grazing during the first spring and summer appears necessary to keep native herbs cropped down and to get the carpetgrass and lespedeza established. Application of 1,000 pounds of basic slag per acre gave slightly better stands and more growth than 500 pounds. A seedbed that was disked as well as burned gave better stands and growth of seeded plants than seedbeds that were only burned. However, there were more undesirable weeds on the disked plot. Bermudagrass and Dallisgrass were not successfully established on these grazed firebreaks.

A green firebreak about a half mile long and 100 feet wide was grown by seeding with big trefoil on a prepared seedbed on the McNeill Experimental Forest in December 1949, in cooperation with the Bureau of Plant Industry, Soils and Agricultural Engineering. During a part of the 1951 growing season, this firebreak was grazed by cattle to reduce winter fuel and competition of the native grass. Two years' growth indicates that big trefoil--when it is grazed--is a desirable forage species for seeding green firebreaks on upland soils in this territory.

Range nursery trials

Forage grasses and legumes not native to central Louisiana are being tested for adaptability to forest range conditions in a small nursery started at Alexandria in 1950. Both warm- and cool-season growers were planted. The nursery was cultivated and fertilized enough to get the plants established. Thereafter, the plants were protected from grazing but not cultivated--they have had to compete with native vegetation.

Sericea lespedeza (*Lespedeza sericea*) and yellow bluestem (*Andropogon ischaemum*) were the only warm-season herbs that grew and reproduced successfully. Hairy indigo (*Indigofera hirsuta*) grew abundantly and had a good seed crop in 1950, but it did not make a stand in 1951. Crimson clover (Trifolium incarnatum) and subterranean clover (Trifolium subterraneum) were the best winter growers. Both species made good growth and reproduced in 1951. For other species, growth and seed production were poor. No species grew successfully without fertilizer. Best growth was obtained on disked plots. Sericea lespedeza and yellow bluestem reproduced in the native rough.

FOREST UTILIZATION SERVICE

The Forest Utilization Service continued to operate as a liaison between the U. S. Forest Products Laboratory, other forest-products and utilization research groups, and the timber growers and wood-using industries of the South.

Hardwood Sawlog Grades and Grade yields

Three training schools on the use of hardwood sawlog grades were conducted in 1951 for 92 enrollees. One of these, at Pineville, Kentucky, was held for the Central States Forest Experiment Station and was sponsored by the Division of Forestry of the Kentucky Department of Conservation. The other two were conducted within the Southern Station's territory, and were sponsored by the Texas Forest Service and by the lumber industry. These bring the number of such schools to 19, and the total attendance to 409.

The results of the 1949-1950 cooperative study with the TVA on log grades and products grade yield were reported in a publication entitled "Circular sawmills in the Tennessee Valley region." This well-designed publication, illustrated with photographic charts, will be primarily used by TVA forestry personnel in discussing with small sawmill operators ways and means of improving the quality of their products and their operating efficiency, and thus increasing income. The study also yielded two other publications, "Sawmill facts," and "Good management--key to successful sawmilling."

The Forest Utilization Service cooperated with the TVA in a new study designed to relate log grade and scale to logging costs. At 15 small sawmills, time studies are being made on all phases of the complete logging job from the stump to the mill. This study will be correlated with the findings of the study of log grades and grade yields. Log grade data for complete trees were taken for the purpose of establishing tree grades.

Participation in the study of low-grade hardwood logs with the Texas Forest Service was confined to reviewing and revising the reports. The study covered detailed data on 530 logs of U. S. Forest Products Laboratory grade F3 and lower. These data included log diagrams and, for the initial phase of the study, determined grade yield in terms of standard factory lumber. Analysis of the data, using lumber value indices, indicated that log diameter and clear cuttings were major factors in the segregation of such logs into classes and grades. As a result, proposed specifications, based on diameter and clear cuttings, were worked out for three segregations of these inferior upland hardwood logs.

In a follow-up to this study, a test of the segregations was made on an additional 579 low-grade hardwood logs sawn at 5 east Texas commercial sawmills. The grade recovery from these test logs closely approximated the results obtained in the original study. The results of this cooperative study will be published by the Texas Forest Service under the title, "Standard lumber recovery from inferior upland hardwood logs of east Texas."

The eastern forest experiment stations (including the Southern Station) and the Forest Service regions active in the development of log and tree grades met at the Forest Products Laboratory at Madison to discuss the growing demand for additional data on log grades and the widely divergent approaches to the problem. The Forest Products Laboratory is preparing a master plan to coordinate research--both within and without the Forest Service--on matters relating to log and tree quality.

In 1951 the Forest Utilization Service assisted several wood utilization firms with extensive forest land holdings, as well as public agencies with large acreages of forest land, in sorting logs by class and quality for various products. The work was done at the request of the landowners, and the call for it is a mark of the trend towards a better and more integrated utilization by the large forest owners in the South. The growing demands for improved utilization will be more fully and properly answered as additional data for log and tree grades, within product classes, are made available.

Wood Seasoning

The final report on the cooperative study of improved and accelerated kiln schedules for hickory handle squares was completed. The results were published by Mississippi State College. These kiln schedules will enable the local manufacturers of hickory handle stock to improve the quality of the products and the efficiency of the kilns.

The Forest Utilization Service has been assisting industry in the use of the new Forest Products Laboratory kiln schedule for drying heavy white oak and Douglas-fir for laminated, non-magnetic mine sweepers.

The use of "Saligna" as a seasoning aid is being tested in a cooperative study by the Texas Forest Service and several east Texas firms. The reduction in the amount of degrade, as well as an increase in the number of usable pieces, has convinced these firms of the benefits of this treatment in commercial application. Such application may be expected to expand, particularly for refractory species or in areas having weather conditions that make drying difficult.

The Forest Utilization Service is cooperating with a large equipment manufacturing firm in Texas in the development of a solvent seasoning process using perchloroethylene at 180° F. followed by a vacuum. It is anticipated that a rather complete and continuous drying operation will be carried out in a matter of hours. The cycle will include drying, salvaging of extractives, treating with preservative, and re-drying in the same cylinder. The company has reported satisfactory drying of pine and gum, but oak has given considerable trouble.

Wood Waste

The interest in Occasional Paper 115, "Amount of chippable waste at southern pine sawmills," has continued to grow. The difficulty of removing the bark is still the chief obstacle to the utilization of southern pine sawmill waste. Recently, however, two of the firms cooperating in the waste study shipped 50 southern pine logs to Sweden, where they were successfully debarked with the Andersson barker. One Andersson barker, together with chipper, has been installed at one of the large Arkansas sawmills. Several other sawmills, as well as the pulp and paper companies, are definitely interested in the utilization of heavy sawmill waste and are considering similar installations. The barker, which is now being manufactured in Alabama, will facilitate development in the field of wood-waste utilization.

Wood Preservation

Fence Post Preservation

The 15-year inspection of the Delta fence post service test was made in 1951. Of the untreated durable native species, all of the osage orange posts, 42 percent of the hill-grown black locust, 40 percent of the mulberry, and 17 percent of the Delta-grown black locust remain serviceable. Average life of the untreated overcup oak and honey locust posts was 4.5 years. Sap cypress posts lasted 5.6 years. Of the posts treated with creosote (6 pounds of creosote per cubic foot of post), all but the cottonwood are sound. Only 1 of the 12 cottonwood posts remains serviceable. Cottonwood, along with willow, is hard to treat because the preservative seldom penetrates evenly.

A 10-year inspection was made of posts treated at the Delta Branch's hot-and-cold-bath creosoting plant. Posts of all species except cottonwood and willow are holding up well. Only 54 percent of the willow posts and 67 percent of the cottonwood posts remain in service. The posts in this test were treated with approximately 8.5 pounds of creosote per cubic foot of wood.

One major fence post test was carried out by the Delta Branch in 1951. Some 5,000 hardwood fence posts were treated with 5 percent pentachlorophenol by the hot-and-cold-bath method. The posts are for use on the farm of the Mississippi Agricultural Experiment Station. The average total cost per post--40 cents--was in line with previous tests in which inexperienced labor was used.

TVA's coordinated fence post project is under way. The aim of the project is to study the application, by the cold-soaking method, of two oil-soluble preservatives, 5-percent pentachlorophenol and 0.5-percent copper naphthenate. Posts of a number of species of pine and hardwood have already been treated and set out. The results to date have been summarized, but the report was delayed by the inclusion of a side project on the effect of bug-peeling on the preservative treatment.

"Fences for bottomland farms in the Delta" was published as Bulletin 483 of the Mississippi Agricultural Experiment Station. The bulletin, which was written by the Delta Branch of the Southern Forest Experiment Station, gives practical directions for selecting, cutting, peeling, and seasoning posts; for treating them by the hot-and-cold-bath method; and for building fences.

Hot-and-cold-bath schedules, for both creosote and pentachlorophenol, are given for the bottomland species most commonly used for fence posts. The bulletin estimates that, at 1950 rates, posts could be cut, seasoned, and treated for about 40 cents apiece.

Fence Post Peeling Machines

Two new fence post barking machines were examined in connection with the revision of the publication on fence post barkers.

The Hurricane Post Peeling Machine, of which 30 are now in operation, will produce from 1,200 to 1,800 posts per day. The rate of feed and pressure on the floating cutter-head are both controlled hydraulically. The machine produces a clean, good-looking post, acceptable to the large wood-treating companies. While it is much more efficient on fence posts, it is also used on small poles up to 30 feet in length.

A locally made drum type peeler, very similar to the commercial pulpwood peelers, produces from 1,000 to 1,200 well-peeled posts per day. The posts feed in at one end, move through the slightly tilted drum, and are discharged when the bark is removed.

Miscellaneous Projects

The Forest Utilization Service participated in two cooperative defense projects, a survey of the equipment, manpower, and supplies used by the southern wood-using industry in 1950, and an analysis of the wood used at military installations. The southern phase of these projects was completed in 1951.

A complete list of the gang sawmills operating in the South has been made in preparation for a gang sawmill study. Over-all work plans have been prepared and arrangements made to carry on detailed studies at installations of the Esterer, Sunbo, Heaps, and Ocala types of mills.

Sample bolts of all four southern pines were collected and shipped to Madison, where the Forest Products Laboratory is beginning a study of the anatomical features of southern pines.

The Forest Utilization Service is cooperating with the Texas Agricultural Experiment Station, Texas A & M College, in a study wherein wood molasses, corn molasses, citrus molasses, dried molasses, and blackstrap molasses are being compared to ground sorghum grain as a fattening ration for beef cattle. Because of delays in obtaining molasses, this study, together with one on the effect of wood molasses on milk production, had to be carried over from last year.

FLOOD CONTROL SURVEYS

Watershed surveys to formulate recommendations for waterflow retardation and soil erosion prevention in aid of flood control are an important Station activity. The survey schedule for 1951 included: going forward with two survey projects under the Interagency Arkansas-White-Red River Basin study; starting a survey of the Hatchie River and contiguous drainages in west Tennessee; assisting the Soil Conservation Service on forestry phases of 7 survey projects (Trinity-San Jacinto, Red, Upper Arkansas, Washita, Apalachicola, Altamaha, and Coosa); handling rush revision of survey recommendations for the Osage River (Missouri River Interagency study); and completing additional revision of some 7 survey reports now in advanced stages of agency review and clearance.

Of high priority were survey activities contributing to the work of the Federal-State Interagency Committee for the Arkansas-White-Red River Basin. Created in 1950, this Committee is to complete by 1954 a comprehensive resource-development plan for the Basin, utilizing all agency facilities and information. During the year the flood surveys group made many contributions to the Basin study. Special service jobs included drainage area determinations; summarization of basic land statistics; inventorying hydrologic data; and preparing a research report on watershed contributions of forest lands.

Much assistance--largely inseparable from the flood surveys job--was also supplied Interagency subject-matter teams in developing and correlating background data for estimating conservation needs. Survey personnel participated in the work of some 10 of these Federal-State teams. Implicit in the Interagency Basin study is need for mutual agreement on basic data and procedures to enable joint consideration and choice of the resource-development projects for the final Basin plan. Particularly important in this respect were various conferences with representatives of the Corps of Engineers to interchange data and to work out division of responsibilities in evaluating flood damages and benefits for specific stream reaches.

A continuing job was revision of the Upper White River survey report to incorporate suggestions of Federal and State agencies. By the end of the year the report had cleared the Department and was ready for final review by the States and by agencies represented on the Federal Interagency River Basin Committee.

Survey findings for the Ouachita and Lower White River Basin are to be incorporated in the Arkansas-White-Red River Basin plan rather than presented in separate reports. Nearing completion at the close of the year were watershed treatment recommendations for the Ouachita River Basin and a first appraisal of costs and benefits.

Considerable work remains before the Lower White River Basin can be brought to similar status. However, much progress was made in area classification, floodplain mapping and damage appraisal, engineering studies to determine need and justification for small detention reservoirs, and in program formulation.

With help from the State Forester and the Central States Station, revised estimates of forestry needs in aid of flood control were formulated for the Osage River Basin in Missouri. These estimates were incorporated with recommendations for a comprehensive agricultural program developed by the Department's Missouri River Basin Interagency Field Committee. Another special study, made at the request of the Corps of Engineers and completed during the year, was an appraisal of damage to timber from flooding of Little River (Arkansas and Texas), and of the potential damage in the event Millwood Reservoir or alternative impoundments are constructed.

During the year a survey was started of Hatchie River and adjacent drainages (Tennessee and Mississippi). Restudy of a 1942 preliminary examination report resulted in recommendations that Loosahatchie River be included in the survey of Hatchie and Wolf Rivers. Surveys of these streams by the Corps of Engineers are going forward concurrently, with indications that the Corps will recommend that channel improvement plans be contingent on accomplishment of erosion prevention and waterflow retardation measures on the watershed lands. Progress on the Station's survey project included preparation of work plans; completion of a field survey appraising hydrologic condition of forest lands; and development of area classification procedures utilizing aerial photo interpretation and analysis.

Cooperative Assistance to the Soil Conservation Service

In addition to its own projects, the Station assisted in forestry phases of 9 surveys for which the Soil Conservation Service has major responsibility.

Additional revisions, pursuant to review by the Washington office of the Forest Service, were made in forestry recommendations for the Lower Arkansas and Savannah River reports--both nearing final Interagency review and clearance. Estimates of forestry needs and cost-benefit appraisals were also completed for the Washita, Upper Arkansas, Trinity-San Jacinto, and Apalachicola River surveys. Moreover, these draft reports received detailed Service-wide review and also necessary follow-up revision at the field level. Work during the year on forestry phases of current surveys included that for the Coosa River above Rome, Georgia; the Altamaha-Ogeechee drainage; and the Lower Red River Basin.

Survey Findings Point Up Watershed Treatment Needs

Survey recommendations, when enacted into law by the Congress, afford Federal authorization for large-scale treatment of watershed lands. Although the primary function of the surveys is to supply Congress with factual data on need and justification for recommended work, they also develop technical information of considerable usefulness to public land-managing agencies. Among other things, the surveys afford insight into the condition of watershed lands and help develop the criteria for judging this. They also show how land use practices affect water and soils, and disclose ways and means of restoring watershed values.

Judging from field examinations completed in 9 major drainage basins from Georgia to Texas, very little of the South's forest lands are in good watershed condition, even though there has been remarkable forestry progress in recent years. In no basin studied does the forest land in good hydrologic condition exceed 6 percent of the total; and about half to three-fourths of the land is in quite poor condition. The latter category includes many millions of acres of relatively well-stocked forest lands in the deep South which have sustained damage to soils that greatly lessens their capacity for water intake and storage.

For the most part, recommended treatments in aid of flood control are those which also better timber, forage, and other resources. Tree planting, control of woods grazing, and improved timber management are basic requirements for watershed rehabilitation as well as for other forestry purposes, although different intensities of treatment and standards of performance usually obtain where watershed improvement is the principal objective.

In most areas, a key measure in watershed treatment is improved fire protection. Although the South's area of unprotected forest land has almost been halved in the last 6 years, some 60 million acres are still without organized protection of any kind. In many parts of the South, fire control is now approaching the level of needs for satisfactory timber management as prescribed in Clarke-McNary goals. In most southern States this means limiting the average annual burn to about 1 percent of the acreage under protection. However, recommendations in aid of flood control generally call for a protection system which will hold the average annual burn to as little as 0.25 percent in the more critical watershed areas, and to about 1 percent for the more fire-resistant types such as longleaf pine. Decision in such matters rests largely on observations of the time it takes watershed lands to recover after a fire, and technical judgment as to the total burned acreage that can be tolerated without sacrificing flood control objectives.

To achieve substantial reduction in flooding, land treatments sometimes must be supplemented with structural measures for waterflow retardation or channel stabilization. Among the many works of improvement considered in flood surveys are systems of small detention reservoirs to reduce frequency and extent of flooding. Specifications usually provide for a rolled earth-fill dam with an uncontrolled outlet for drawdown and a spillway for discharge of excess floodwaters. These impoundments are commonly designed for temporary storage of 3 to 7 inches of runoff from drainages ranging from 1 to 35 square miles. Since they permanently flood only the limited areas in conservation pools, small detentions can often be employed effectively in the upper reaches of minor tributaries with minimum dislocation of land use. Whether they are economic--singly or in a system--depends on many factors of cost and on sufficiency of damages downstream that cannot be alleviated by recommended land treatment measures. In designing and appraising need for these and similar structures, the flood surveys are making an important contribution to a much-publicized but long-neglected field of upstream engineering.

EXPERIMENTAL FOREST DEVELOPMENT

Alexandria

A compact block of 2,320 acres of open, cut-over longleaf pine land on the Longleaf Tract of the Palustris Experimental Forest was hog-fenced during spring and early summer, 1951. Cross fences of 4-strand barbed wire were then erected to divide the area into 4 pastures of about 580 acres each. A good set of pens, chutes, and weighing facilities were constructed where the four pastures corner.

The main road across the Longleaf Tract was spot-gravelled for its entire length and made an all-weather road. Several side roads were constructed but not gravelled. They are passable except in wet weather, and open up areas previously inaccessible by automobile.

Pine plantations on the Johnson Tract of the Palustris Experimental Forest suffered heavy damage from the ice storm January 30 to February 4, 1951. Slash pine was hit the hardest. One 200-acre block of 15-year-old slash pine (thinned by an incendiary fire in August 1947) was damaged so badly that it had to be clear-cut. On another 600-acre block that was less severely damaged, only bent or broken trees not expected to survive for 5 years were cut. The clear-cut block yielded 11 cords of salable pulpwood per acre, and the less damaged, selectively cut block yielded over 3-1/2 cords per acre. In each case a commercial operator paid about $3.50 for the stumpage. Ten cords per acre remain on the partially cut block. Additional salvage operations were conducted on scattered areas.

Direct seeding was attempted on some of the salvage-cut areas, and planting on others.

Birmingham

Cutting on the Flat Top Experimental Forest was continued at the usual rate. The 1951 harvest was 12,828 mine props and 65,800 board feet of logs. Most of this cut came from commercial stand improvement cuttings in low-grade hardwoods. Cull trees were girdled on 144 acres.

Brewton

A new research project was initiated during the year in the west Florida scrub-oak sandhills. Headquarters will be at Marianna, Florida. A cooperative agreement between the U. S. Forest Service and the Florida Board of Forestry, signed in September 1951, will make available $20,000 per year of State funds to match or supplement Federal funds spent on this work. The State funds were appropriated by the Florida State legislature specifically for work in this area. After extensive reconnaissance, a new experimental forest was tentatively located near Blountstown, in Calhoun County, Florida. Negotiations with the two owners of the tract were begun, with the object of preparing cooperative agreements for the use of the land.

On the Escambia Experimental Forest 1,260 acres of longleaf pine seedlings were prescribe-burned for brown-spot control in February 1951, and about 80 acres were burned for seedbed preparation just before seedfall.

Hog trapping was continued with fair success. Arrangements are being made to hog-fence the entire forest with the cooperation of the adjacent landowners. Wildfires in 1951 were the worst ever, possibly because Alabama stock owners wished to attract their cattle into new burns and avoid having them stray into adjacent Florida, where a new stock law would have impounded them. The Alabama stock law goes into effect June 1, 1952, and will eliminate this incentive.

Central Ozarks

Detailed maps of both the H. R. Koen and the Sylamore Experimental Forests were largely completed.

Plans for improvement cutting and for timber stand improvement work on the Sylamore Experimental Forest were revised and completed. A total of 730 acres were marked for cutting and 1,100 acres of pine and hardwoods other than white oak were cut. The white oak cutting was completed, as was 1,116 acres of stand improvement work. Timber stand improvement demonstrations were established on 106 acres.

Crossett

After only 13 years of management, the "poor" farm forestry forty has been converted from a run-down stand of pine and hardwood to a well-stocked, highly productive pine stand. Growth of trees of all sizes is now more than 1-1/4 cords per acre per year, and growth of sawlog-size material is nearly 400 board feet (Doyle scale) per acre per year.

During the year 784,000 board feet (Doyle scale) of logs, 930 cords of pulpwood, and 125 units of chemical wood were cut from the Crossett Experimental Forest and delivered to plants in

Crossett. Over 80 percent of the volume of forest products due the Crossett Lumber Company under terms of the deed to Unit I of the Forest has been cut and delivered.

In cooperation with the Crossett Lumber Company, an attractive new Guide to the Crossett Experimental Forest was published.

Delta

During 1951, 160 acres of the Delta Experimental Forest were given a commercial improvement cutting for sawlogs; 105,490 board feet (Doyle scale) were removed. Cutting was confined to trees in obvious need of removal for reasons of silviculture or salvage. An analysis of costs shows a favorable margin of $9.00 per MBM between costs and returns. Neither supervision costs (except for wages of a straw-boss) nor equipment depreciation has been charged against the margin as yet.

Since the establishment of the Branch in 1946, improvement cuts have been made on 360 acres of the Forest.

East Texas

In 1951, drouth and Ips beetles killed approximately 50 MBM of pine timber on the Stephen F. Austin Experimental Forest. Dead saw timber, a few poor-risk trees, and the annual cut from the farm forest were combined in one timber sale.

Administration and protection of the Forest was greatly improved by the installation of commercial telephone service, the extension of the water line and installation of a fire hydrant and hose, and the hiring of a resident foreman.

Gulfcoast

In January 1951, three compartments of the Harrison Experimental Forest were prescribe-burned and (together with one that had been prescribe-burned in 1947) leased for a three-year naval stores operation. The lease was for a total of 8,749 faces on 311 acres. The rate was $0.082 per face per year.

In November and December 1951, three compartments were prescribe-burned and, together with one other that was burned in 1947, were marked for a three-year naval stores lease starting in 1952. The total area is 324 acres, and about 10,300 faces were marked. On four other compartments, trees were marked for an improvement cut that will remove most of the old-growth pine and some rough second-growth. Total volume marked was 547,835 board feet (Scribner Decimal C) on 338 acres.

Tallahatchie

Twenty-nine thousand pine seedlings were planted on eroded areas and old fields in the Tallahatchie Experimental Forest. About 1.7 miles of new class E road were constructed under the supervision of the Mississippi National Forests. An REA power transmission line was erected across the Forest adjacent to Forest Service Road 603. This line passes through the headquarters site, and will provide power for any buildings constructed in the future.

COOPERATING AGENCIES

Bureau of Plant Industry, Soils and Agricultural Engineering

Tree diseases

Fusiform rust of southern pines.--Efforts to increase the resistance of slash pine plantings through use of superior geographic strains apparently hold little promise. On two test plots in Mississippi, the one strain that appeared highly resistant heretofore, the "south Florida" slash pine of doubtful identity, suffered over 50 percent mortality from the cold winter of 1950-51. All other strains, which range in source from South Carolina to Louisiana, still show only minor and inconsistent differences in several plantings of 4 to 8 years in age. Similar comparisons for six strains of loblolly pine must await longer exposure in the field.

After 3 years in the field, loblolly pine seedlings from healthy parents show slightly more infection than those from cankered parents, thus reversing the results for 2 years of exposure. Such erratic and often minor differences also have been obtained in 3- to 6-year old slash pine plantings. It appears that little or no reduction of cankering of either loblolly or slash pine can be expected from using healthy trees as the only seed source.

A preliminary trial of pruning cankered branches from 2-year-old slash pine having no stem cankers was made in May 1950. Prior to treatment, 45 percent of the seedlings in the pruned area and 34 percent of those in the untreated plot were cankered. Two growing seasons later, 36 and 39 percent of the trees were infected in the pruned and unpruned areas, respectively. These results indicate that pruning may be of limited value for plantings that became heavily infected within the first two years.

Attempts to further improve nursery spray treatments for rust control gave inconclusive results because of the low incidence of infection in the check plots (about 1 percent). Practically all plots sprayed with materials recommended at present showed no infection.

Brown spot of longleaf.--Trials of nursery sprays, applied in March, May, August, and October, demonstrated that formulations similar to Fermate, Zerlate, and Ferradow were as effective as 4-4-50 Bordeaux mixture in controlling the brown spot disease of longleaf pine. Effective control also was obtained with 2½-4-50 Bordeaux mixture. Therefore, use of a single material of the Ferbam or Ziram type for both brown-spot and fusiform-rust control appears to be safe practice at nurseries that heretofore have employed different materials for the two diseases.

Resistance to the brown spot disease was strongly indicated by scattered seedlings in the heavily infected untreated plots. Such seedlings will be selected for propagation in a disease-resistance test.

New diseases and outbreaks.--New spots of infection of the oak wilt disease were located in the course of cooperative surveys during the summer of 1951. However, the new locations did not extend the southernmost distribution of the disease in this territory.

An outbreak of the oak leaf blister disease was conspicuous during spring and early summer over much of the southern half of the region. Defoliation and browning were particularly common on red oak, water oak, and other species of the black oak group. Only minor damage resulted from the attack.

Nursery diseases.--The first large-scale use of a cheaper, more concentrated form of ethylene dibromide for control of root rot at the Ashe Nursery was made in the spring on approximately 25 acres that were later sown to longleaf, slash, and loblolly pine. This material, known as Dowfume W-85, was applied at a rate of 7.5 gallons per acre, which corresponded to 25 gallons of the 20 percent (by volume) solution used heretofore. Satisfactory root rot control was obtained in all beds that had been lifted by the end of December.

The carry-over effect of previous treatments with ethylene dibromide was tested again on spring-sown crops of loblolly and shortleaf pine. Although some degree of control was still evident in the second successive pine crop after treatment, it was not sufficient to be practical. Very little effect carried over to the third crop.

Preliminary tests at the Ashe Nursery indicated that shortleaf pine also suffered high mortality in the seed bed as a result of the root rot. The first adequate tests with this species were conducted in 1951; they showed that plots fumigated with ethylene dibromide produced 55 percent more plantable seedlings than those that were untreated.

For four successive years the same areas have been fumigated each spring with ethylene dibromide and sown to pine. The fourth crop was loblolly grown in 1951. Excellent root rot control was again obtained, and there was no evidence that the repeated treatments had had deleterious effects on the quantity or quality of seedlings. Therefore, no difficulties are anticipated from repeated use of this chemical at the Nursery. Further studies on the control of the Ashe root rot are not contemplated.

A root rot of similar appearance to that at the Ashe Nursery has affected white pine but not Norway pine at the Chittenden Nursery in Michigan. To ascertain whether causes might be the same, white and Norway pine seed from the Lake States was spring-sown at the Ashe on ethylene dibromide-treated and on untreated plots. Seedling mortality was high with both species in untreated plots but very low in fumigated plots. When lifted in December, 1951, the living seedlings from untreated plots showed severe root rot, while those from treated plots had practically no rot. The green weight of the seedlings was consistently less in untreated than in fumigated plots. But since both white and Norway pine appeared highly susceptible to the Ashe root rot, it appeared that the causes of the rots at the two nurseries probably are not the same.

Cooperation in the form of personal visits was extended two nurseries in Michigan and West Virginia in connection with root rot problems. There is little doubt that similar root rots exist elsewhere.

Decay in buildings and other construction

On-the-job preservative treatments.--An evaluation of factors affecting the penetration and absorption of oil-carried preservatives into southern pine by on-the-job applications indicated that: (1) Fungus infections greatly increase both penetration and absorption of preservative solutions. Molds were most effective but sapstain and decay also increased permeability; (2) Ends coated with dried oleoresins are relatively non-permeable; (3) Rough lumber absorbs more solution than dressed lumber; (4) Treated wood is resistant to retreatment after the preservative dries. When the previous treatment contains moisture repellent materials, this resistance may last for several years; (5) As previously reported, sapwood and end grain are much more permeable than heartwood and lateral grain. Differences of practical magnitude were not found for (a) different individual pine trees, (b) kiln-dried versus air-dried wood, (c) weight of oil carrier (limited to paintable treatment types), (d) specific gravity of the wood, (e) height of wood in tree, (f) radical position in sapwood, except that the ring or two next to the heartwood was resistant to treatment.

The evidence is that, in the absence of fungus infections, shallow treatments only will be obtained from immersion periods likely to be practical for on-the-job use. Although such treatments can be very helpful, the new data further emphasize that on-the-job applications must be used with care and only in conjunction with sound construction practices for the protection of exterior woodwork of buildings.

Siding studies.--A greatly enlarged test of construction practices in relation to siding decay confirmed earlier survey observations that little roof overhang, use of non-breathing sheathing papers, and butting of siding to trim are among the most common practices associated with decay. Two other points already are clear from the new tests: (1) The addition of wood sheathing greatly increased moisture accumulations in siding, whether or not building papers were used between the siding and sheathing. (2) In siding panels subject to heavy water seepage, a 3-minute dip of siding in a moisture-repellent preservative solution was highly effective in preventing wetting of the siding. The practical significance, in terms of decay occurrence, of these and other variables under test must await longer exposure of the new siding installations.

Service activities.--Inspections that led to recommendations for decay control were made of both private and governmental construction, including buildings, floating dry docks, and non-magnetic mine sweepers. Instruction on decay problems was given to military personnel in Georgia and South Carolina, and to agricultural engineers in Texas.

Mold occurrence and effects on wood

Additional tests confirmed earlier findings that fresh southern pine wood given a surface treatment with fluoride solutions develops a luxuriant growth of green mold (Trichoderma), and that such treated and molded wood: (1) remains surprisingly free of decay and sapstain during seasoning; (2) becomes increasingly permeable to oil and water solutions.

Trials on six different hardwoods and cypress indicated that only sap gum (Liquidambar styraciflua) responded to the fluoride treatment in the way that southern pine does. The development and effects of the mold were of smaller magnitude on sap gum than on pine.

The revelation that mold infection greatly increases permeability of pine has helped to explain some of the variable results obtained in applying and testing non-pressure preservative treatments. It also has become evident that reasonably uniform absorption and penetration of preservatives in air-seasoned pine cannot be expected unless the wood, prior to treatment, is fairly comparable in mold and other fungus infection.

Laboratory studies have indicated that: (1) Solutions containing fluorine are much less toxic to Trichoderma mold than to most sapstain and decay fungi. Although chemical stimulation of mold development has not been ruled out entirely, it appears that elimination of competitive organisms mainly explains the luxuriant molding of fluoride-treated wood. (2) Growth of the mold is concentrated in the wood ray and other parenchyma cells, often leading to their complete breakdown. Such attack provides radial paths for liquid movement and probably explains in large part the increased permeability of the wood. (3) Although Trichoderma has antibiotic effects on many fungi, other factors may be as or more important in the absence of decay and sapstain in the fluoride-treated, molded wood.

Deterioration of stored pulpwood

Rough pine pulpwood.--Three additional studies on pulpwood deterioration, completed during 1951, confirmed earlier findings that losses in specific gravity due to decay are likely to range between 11 to 15 percent after 1 year of storage. For summer storage (April 15 to October 15), losses usually have ranged between 2 to 4, 6 to 8, and 8 to 10 percent after 2, 4, and 6 months of storage, respectively. For corresponding periods of winter storage, specific gravity was reduced 0+ to 1.5, 1.5 to 3, and 3 to 5 percent. Factors leading to losses on the low side of the ranges have included: above-average size of bolts, storage in large unaerated piles, abnormally cold winters, and use of chemical control treatments. Deterioration has been similar for Arkansas and Coastal areas during summer storage but somewhat slower in Arkansas during winter or for one full year of storage.

The following recommendations for reducing damage were released during the year (Southern Forestry Notes No. 76, November 1951): 1--Cut and store during fall and winter, provided storage is for less than one year. 2--Favor as large bolts as possible for storage. 3--Cut and store as long bolts as possible. 4--Store in large, unaerated piles. 5--Spray ends of freshly cut bolts with a 4-percent solution of sodium fluoride in water. Although this latter treatment can be expected to slow down losses greatly, it will not permit indefinite storage such as is possible if fresh-cut pulpwood is stored in water. Therefore, the practices of storing only as long as necessary and of using the oldest stored bolts first are still important.

Peeled pine pulpwood.--Two studies completed in 1951 again indicated that peeled pulpwood shows greater variation in deterioration than rough wood; also, that peeling of wood reduces losses during storage periods that exceed 2 to 3 months in summer or 4 to 5 months in winter, but may be detrimental for shorter storage periods.

For peeled bolts of average size, losses in specific gravity usually have been between 4 to 6 percent after 4 months and 5 to 8 percent after 1 year, but have ranged from 2 to 7 and 3 to 9 percent, respectively. Invariably, rapid deterioration during the first 4 months has been followed by slow and erratic later losses. In contrast, large bolts of 10 inches or more in diameter, unless split into halves or quarters, have continued to deteriorate until losses after 1 year reached as high as 14 percent.

Other factors than large bolt size that have increased deterioration include delayed "insect peeling" of the bolts, piling in such manner that drying is very slow, and exposure to abnormally long spells of wet weather at any time during storage. The effect of season of cutting and storing has been less consistent than with rough wood.

The recommendations made for reducing damage were as follows:
1--Hasten drying of the bolts through improved ventilation of piles.
2--Favor small bolts for prolonged storage or split large ones.
3--Peel as soon as possible. 4--Spray or dip the pulpwood immediately after peeling with 4-percent sodium fluoride in water.
5--Cut and store during fall and winter (generally, but not always, of value).

Hardwood pulpwood.--Since there is increasing interest in losses suffered by stored hardwoods, a preliminary test comparing rough, peeled, and chemically treated sap gum was established in December 1951.

Bureau of Entomology and Plant Quarantine

Southern pine beetle

The southern pine beetle (Dendroctonus frontalis Zimm.) continued to kill large numbers of pines in eastern Texas during the first half of 1951. After July, however, beetle activity subsided rapidly despite a favorable period of warm and rain-deficient weather. Investigations revealed that numerous insect predators and a disease were present. These natural control agencies and the prompt control measures effected through close cooperation between private industry, the Texas Forest Service, and the Division of Forest Insect Investigations have no doubt resulted in the decline of the epidemic. Since late 1950 the above organizations carried out a program that resulted in the salvaging of 45 million board feet of saw timber and 36,000 cords of pulpwood from an estimated 55 million board feet of infested saw timber and 50,000 cords of infested pulpwood. Many infested trees that were too scattered or inaccessible to be salvaged were felled by small crews and treated with oil solutions of .25 percent gamma benzene hexachloride in order to kill existing broods and prevent subsequent damage.

Black turpentine beetle

Pine trees in turpentine groves and forests throughout the South have been killed during the past three years by the black turpentine beetle (Dendroctonus terebrans (Oliv.)). Most outbreaks during the past year occurred on or adjacent to areas where some cutting recently was carried on and where fresh stumps afforded a suitable habitat for a buildup of populations.

Mortality of attacked trees has been high. A record kept on eighty attacked trees on the McNeill Experimental Forest revealed that more than 60 of them had died six months after they were first observed. Although it was evident that most of these trees had been girdled by larvae, some of the dead trees did not appear to have been girdled. Subsequent root-washing studies disclosed that attacks extended to depths of 3 feet beneath the soil surface and that lateral roots often were heavily attacked. When these attacked laterals came in contact with roots of other pines the attacks very frequently extended up the roots of the other trees.

Results from other tests conducted on the McNeill Experimental Forest show that in areas with large beetle populations treatments of 10 percent benzene hexachloride dust applied to stumps immediately following cutting operations prevented infestations in these stumps and thereby reduced subsequent attacks to nearby trees. Oil solutions and water suspensions of BHC were also effective, whereas oil solutions of both DDT and chlordane were unsatisfactory.

Other tests that are being conducted indicate that spray treatments of BHC are effective in preventing new attacks and controlling existing beetles in living trees.

Loblolly pine sawfly

Defoliation by the loblolly pine sawfly (Neodiprion sp.) in Louisiana and Arkansas this year was confined to a slightly smaller area than the 800,000 acres infested in 1950. Some infestations disappeared entirely while others expanded.

Life history studies revealed that hatching took place during the first three weeks in March and that the sawflies had spun their cocoons by the end of April.

Excellent control was obtained last spring near Urania, Louisiana, on a 1,500-acre pine forest that was sprayed by airplane with DDT at the rate of 1 pound per acre. From collection trays placed under sample trees, it was found that heaviest larval kill occurred 2 days after spraying, although some of the more advanced larvae did not die until 7 days later. Heavy rains shortly after spraying did not appreciably reduce the effectiveness of the spray.

A larval disease had been noticed for the past few years. This year water cultures were prepared from these infected larvae and used as an experimental spray on healthy larvae.
Samples of both the diseased and treated larvae were submitted to

the Sault Ste. Marie Laboratory in Canada, where the disease was identified as one of the polyhedron viruses. Samples of both the diseased and sprayed larvae yielded high counts of the virus.

Ambrosia beetles

Log tests were established at Brewton, Alabama, in July 1951 to determine if the addition of various sticking agents and heavy carriers to fuel oil would increase the effectiveness of benzene hexachloride on smooth-bark logs such as white bay. Various formulations of BHC without additives also were applied to logs of a rough-bark species, sweetgum.

When the tests were closed in December, it was found that a concentration of 1-3/4 pounds of gamma BHC per 50 gallons of No. 2 fuel oil was effective in preventing ambrosia beetle attacks in sweetgum and white bay logs. The addition of 1 percent napalm, 1 percent aluminum octoate, 5 percent SAE 70 motor oil, or 10 percent tall oil NSP 1305 to the fuel oil resulted in a slight increase in the effectiveness of BHC on white bay logs. A water suspension of BHC containing 2 pounds of gamma isomer of wettable BHC per 50 gallons of water also was effective. Since water suspensions of BHC are cheaper than oil solutions, these results are encouraging. Results with emulsions, mists, and dust treatments of BHC were inferior to those from oil solutions and water suspensions.

Screening tests also were established in July with 3-foot bolts to determine the effectiveness of some new insecticides that had not been previously tested as ambrosia beetle preventives. When the tests were closed in November, it was found that 5 percent heptachlor in No. 2 fuel oil warranted further testing; while 5 percent DDD and 1 percent dieldrin, each in No. 2 fuel oil, and 10 percent copper ammonium fluoride complex in water gave poor protection from ambrosia beetles.

Powder-post beetles

Biological studies as related to the control of powder-post beetles were continued. Although Lyctus planicollis normally has a life cycle of about 9 months, it was found that in wood of high starch content the cycle may be completed in 3 months.

Preventive 3-minute dip treatments that were established in 1948 are still in progress. Some of the newer insecticides such as BHC, DDT, and chlordane are still effective, while poor results have been obtained with sulphur, one of the treatments that sometimes had been recommended in the past.

Active infestations of Hylotrupes bajulus have been controlled in 8- by 8-inch pine timbers by fumigating with methyl bromide at dosages of 1, 3, and 9 pounds per 1,000 cubic feet of space at exposures of 24, 16, and 3 hours respectively. Other studies are in progress to determine the effectiveness of brush applications and chemical injections in controlling infestations in large timbers.

Ips and borer control in pine

In a test at Brewton, Alabama, decks of pine sawlogs were treated with BHC formulations and exposed to beetle attack for four months. It was found that 7/8 pound of BHC per 50 gallons of No. 2 fuel oil and one pound of gamma wettable BHC per 50 gallons of water each were effective against Ips and sawyer attacks.

Pine pulpwood in 1/4-cord stacks was treated and exposed to a very heavy beetle population for almost five months at Moss Point, Mississippi. Dust, wettable powder, emulsion, oil solution, and mist treatments of BHC were tested along with DDD, copper ammonium fluoride complex, and sodium fluoride. Although the oil solution of BHC offered the best protection to the pulpwood, medium to heavy attack occurred in all stacks, and none of the treatments, therefore, was entirely satisfactory.

Subterranean termite control

Studies of local termite species and their biology were begun in the Canal Zone. Carton nesting termites and subterranean termites were isolated to observe their ability to survive without moisture.

Field testing of over 97 soil poison treatments since 1946 in Mississippi and the Canal Zone shows that both DDT and BHC in oil gave excellent protection for 5 years. Sodium arsenite gives excellent protection for 7 years but is limited in application because of its extreme toxicity to plants and animals.

Screening tests are in progress in Mississippi to evaluate sealers in preventing termite penetration through expansion joints. Several promising materials are in test.

Studies were begun in Mississippi to determine the toxicity of some of the better soil poisons to shrubbery. Sodium arsenite was the most toxic soil poison tested, while oil solutions, in general, caused some plant injury. Emulsions are promising.

Preservation--fabrics, wood, and wood products

Numerous treatments were applied to cotton fabrics, ropes, and other materials to protect them from termite damage when in temporary contact with the soil. Materials impregnated with either copper naphthenate or copper 8-quinolinolate are still serviceable after approximately 1 year of field exposure.

Studies are in progress in Mississippi and the Canal Zone to determine the value of chemical impregnations, applied by dipping, for the protection of wood from attack by subterranean termites. Tested materials were soaked in cold solutions for time intervals of either 1 second, 3 minutes, 1 hour, or 12 hours. The 3-minute dip in certain formulations offers satisfactory protection to wood products such as crating and boxes for at least 1 year of storage on soil. Longer dips are necessary for units--such as posts, piers, and steps--that are exposed to more severe conditions.

PLANS FOR 1952

FOREST MANAGEMENT

Cuts in appropriations and increased costs have considerably reduced manpower and facilities available for forest research. Accordingly, efforts have been made to obtain more outside cooperation for research in geographic seed source of pines, genetics, and soils, and a new cooperative project in west Florida sandhill scrub-oak has been initiated with the Florida Board of Forestry. No other major new projects are contemplated.

Alexandria

Stimulation of early height growth of longleaf pine will be tested further by additional plantings and field treatments. Tests will include periodic burning for brown-spot control, clipping and dipping to reduce transpiration, chemical control of competing vegetation, and cultivation.

Factors responsible for failures in direct seeding will be sought through analysis of all past tests.

Direct seeding of variously prepared seed beds with stratified and unstratified loblolly pine seed will be conducted in March. In the fall, both stratified and unstratified loblolly pine seed will be sown to explore the possibility of obtaining successful fall germination on hardwood areas. In longleaf pine, studies of direct seeding and of underplanting and release will continue.

A loblolly pine spacing study will receive its first 5-year remeasurement. A similar slash pine spacing study, seriously damaged by an ice storm in February 1951, will also be remeasured.

A stocking study to determine optimum basal area for maximum yield may be installed if a suitable plantation of either loblolly or slash pine can be located.

Birmingham

A third and final series of plots designed to test the effects of various maximum tree sizes and stand densities upon growth per acre per year will probably be installed by June 1952. A total of 375 acres are involved in this study.

Experimental improvement cuttings to cover 1,000 acres are being made as rapidly as the cutting crew can get to them. Details of two additional treatments prescribed by the Division of Forest Economics are now being worked out. At the present rate of progress, several years will be required to install this study. Plans for speeding up this work by increasing the size of the present 3-man woods crew are under consideration.

Continued observation and periodic remeasurements will be made in several planting and genetics studies previously installed.

A manuscript summarizing 5-year results of spoils bank plantings in north Alabama will be prepared.

A study of pruning in old-field loblolly pine will be initiated. Bud-pruning of younger pine will also be explored.

Brewton

No new studies are planned except in the west Florida sandhills. Considerable timber stand improvement and burning will be conducted on the major longleaf management system study at Brewton, Alabama. Logging data collected over the past few years will be summarized.

The study of the effect of competition on longleaf reproduction will be continued, along with one of the timing of release. A survey-type stand-structure study in longleaf of various ages will be summarized and analyzed.

In west Florida, studies will be initiated on control of undesirable hardwoods, site factors affecting longleaf establishment and growth, the nurse effect of scrub oak on underplantings, and species better adapted to sand hills than longleaf.

Central Ozarks

Observations on stand-structure and growth plots will be continued and summarized, as will those on the various planting studies already installed. Redcedar harvesting and management cost data will be summarized for publication.

Timber stand improvement studies on both the H. R. Koen and the Sylamore Experimental Forests will be continued.

Reconnaissance correlating geology, site, and tree species will be extended to new formations.

Crossett

New studies will be undertaken on direct seeding of loblolly on abandoned old fields, the moisture and light needs of loblolly seedlings, and the correlation of growth following release with pre-release crown class in loblolly and shortleaf pines.

Pine thinning, pine pruning, and hardwood control studies will be continued, as will the pilot-plant methods-of-cutting study and the single-tree-selection cutting-cycle study. A publication summarizing the 10-year results of the latter study will be prepared.

Studies will be continued on the effect of understory hardwoods on overstory pine and on the means and speed with which hardwoods reinvade pine sites from which they have been completely removed.

Delta

Major emphasis in 1952 will be placed upon study of the silvical characteristics of the bottomland hardwood species. A new series of plots will be installed to study reproduction under various conditions. Sapling, pole, and sawlog plots will be remeasured and analyzed.

A study of timber stand improvement by girdling or poisoning of undesirables will be started in 1952. Ten-year remeasurements will be made on the improvement cutting plots. An article describing results will be prepared.

Production of cottonwood cuttings in the new nursery on clay soil will be studied. A rotary tiller will be tested to see if it will satisfactorily prepare cottonwood planting sites.

The inventory of the Delta Experimental Forest will be completed, and a management plan for the forest will be written.

East Texas

Studies on the use of Ammate for killing undesirable small hardwoods will be completed.

The study on methods of cutting bottomland hardwoods will be continued. Observations on the establishment of pine seedlings under various harvest cutting systems will be intensified because of the excellent seed crop. The fourth- and fifth-year plots of the D+ system of management will be installed in cooperation with the Soil Conservation Service.

Investigations into the use of fire in forest management are being expanded. The following studies will be established during the year: 1--Effect of season, number, and frequency of burns on the shrubby understory and associated shortleaf and loblolly pines on rolling upland sites. 2--Pilot plant tests of costs and effectiveness of fire as a pine management practice. 3--Use of fire for understory control in a 40-year-old well-stocked stand of shortleaf and loblolly pines. 4--Effectiveness of fire in pine seedbed preparation. 5--Effects of fire on forest soils in east Texas.

Gulfcoast

Reinventory and thinning of three intensively treated compartments and supplemental thinning of one extensively treated compartment on the commercial stand management study will be completed early in 1952. Two of the moderately treated compartments will be marked for thinning in the fall of 1952. A report will be prepared on cutting, inventory, costs, and mortality for four compartments. Parts of three compartments will be burned for brown-spot control, and some hardwood control work will be done. The study is being conducted on the McNeill Experimental Forest.

On the Harrison Experimental Forest, a commercial improvement cut will cover 348 acres.

Growth plots and old pruning studies on the McNeill and Harrison Experimental Forests will be given a five-year remeasurement.

An effort will be made to complete an Occasional Paper on fire effects in the longleaf-slash pine type, and analysis of the relation of crown scorch to pine growth and mortality will be continued. If the 1952 seed crop is adequate, plots will be installed for the seedbed preparation study.

The response of longleaf seedlings to competition will continue to be studied. Special attention will be devoted to the effects of older trees in understocked stands, the effects of trenching in moderately stocked pole-sized stands, and the use of fire in site preparation. Other phases of longleaf regeneration that will continue to be studied include the effect of fertilizer and of seed-tree release on seed production, bar vs. machine planting, ten-year survival and growth of longleaf on old fields and cutover land, and effects of nursery bed density on field survival and growth. Work will be continued on studies of physiological grades, phosphate nutrition, and other nursery practices.

Remeasurements will be made where prescribed burning was employed to stimulate height growth, and where different geographic strains of longleaf were planted in different localities.

Genetics work (mostly inter-species pollination and collection of seed from 1951 crosses) will be conducted on a small scale.

Tallahatchie

Studies of the important characteristics of the seven principal soils of north central Mississippi and western Tennessee will continue. Supplementary studies will be initiated to determine seasonal variations in soil aeration and availability of water under four cover conditions, and to compare available water and air capacities of soils in gullies and on adjacent old fields. Gullies treated in the test of gully control methods will be reexamined and replanted where necessary.

The fourth and final underplanting tests (six conifers under poor upland hardwoods) will be installed--two released and two unreleased plots. Annual plantings made from 1949 to 1952 will be analyzed to determine survival by species, treatment, and year of planting.

Installation of the underplanting study of five valuable hardwood species beneath a low-grade hardwood overstory on fair to good sites was completed in 1951, when the third annual set of plantings was made. The earlier installations will be analyzed to determine differences in first- and second-year survival and in total height after two growing seasons. The analysis will consider species, treatment, site, and year of planting.

A study will be initiated to determine the silvicultural effects of different intensities of timber stand improvement measures for rehabilitating depleted upland pine-hardwood stands.

Preliminary surveys will be made to determine the possibilities of conditioning non-study areas of the Tallahatchie Experimental Forest by improvement cutting followed by treatment of worthless culls.

Remeasurements of the mixed and pure redcedar-pine plantings will permit analysis of three-year survival and growth. The hybrid pine and cooperative seed-source plantings will also be re-examined.

FOREST ECONOMICS

Forest Resources

Tennessee.--A statistical report on forest acreage, timber volume, growth, and drain in Tennessee will be published in 1952. Forest Survey data on timber production and forest industries in Tennessee will also be issued as a Forest Survey Release. Work will begin on an analytical report for the State.

Arkansas.--Computations are in progress for a statistical report of forest acreage and timber volume in the Delta region of Arkansas. This will be followed later in 1952 by a statewide statistical report and a report on forest industries.

Alabama.--The re-survey of Alabama forest resources will continue. It is expected that the west central (Unit 4) and north central (Unit 5) regions will be inventoried by the middle of 1952. Work will be well along in the southwestern part of the State (Units 1 and 2) by the end of 1952.

The results of the survey of the sizes, grades, and quantities of logs, bolts, and other raw materials purchased by the wood-using plants in the Birmingham territory will be correlated with Forest Survey resource data. This will permit the various classes and grades of standing timber to be evaluated in terms of their utility to wood-using plants.

Forest Industry

Compilation of 1950 forest industry and drain data in Tennessee will be completed early in 1952.

Data for estimating 1951 timber drain in Alabama will be collected and compiled in cooperation with the State Forester's office.

Annual pulpwood production statistics for the South will again be obtained in cooperation with the Southeastern Forest Experiment Station and the Southern Pulpwood Conservation Association. The report on 1951 production will be published at the Southeastern Station.

Economics of Forest Management

Guides to profitable forest management.--A study will be made at the Crossett Branch to determine if optimum stocking has been reached on those compartments with stocking over 10 M board feet (International 1/4-inch rule) per acre. Work will continue on the study of the size at which pine seed trees reach financial maturity.

The study of financial aspects of all-aged versus even-aged management of loblolly-shortleaf pine will be continued. It is being carried out near Canton, Mississippi, in cooperation with the International Paper Company. Growing-stock volumes, values, and increment at the beginning of the study will be reported, as will the volume and stumpage value of products cut and sold from the clear-cut even-aged compartments. From current growth rates of the present growing stock, some predictions as to future volumes and values will be made. Methods of measuring the economic advantages and disadvantages of the two methods of management will be developed.

During 1952, an outline and a part of the text of a technical bulletin covering the use of financial maturity as a guide to profitable forest management will be prepared.

Returns from well-managed commercial forests.--Costs and returns will be reported from the 1,000 acres of second-growth shortleaf-loblolly pine-hardwoods managed under the selection system at the Crossett Branch and from the 645 acres of second-growth longleaf managed under group cutting at the Brewton Branch. A report covering 10 years of management of the Crossett forest will be published.

Returns from well-managed small tracts.--Studies of the financial possibilities of small woodlands will be continued at eight branch stations during 1952. Field days will be held in cooperation with other agencies to show farmers and others what products can be grown and harvested and how profitable farm forestry can be.

RANGE RESEARCH

Alexandria

Grazing management.--Important manuscripts on increased grass production after poisoning hardwoods, seasonal forage production, and important range plants are well along toward publication. Installation of the new seasonal grazing management study will be completed. Grazing management plans will be written for each of the cooperators whose cattle graze on the experimental forest under permits issued by the Kisatchie National Forest. The study work plan will be revised.

The study of hog damage to planted pines will be continued. In January 1952, a 2-1/2-acre block will be replanted with year-old longleaf and slash pine seedlings. This tract, the creek bottom, and 2-1/2 acres of the 1951 plantings will be stocked with woods hogs. The electrical fence and chemical repellents will again be tested. The grazing damage survey plots in La Salle Parish will be examined again after the 1952 growing season.

Control of undesirable hardwoods.--In 1952, three chemicals that have done best in previous experiments will be tested in two separate blocks during the spring season. Two concentrations of each chemical will be used, since stronger concentrations are required by some methods of application than by others. The chemical will be applied in frills, on stumps, and with the Cornell tool. These methods are cheaper than the trunk-spray method. Species to be treated include oaks, gum, and hickory.

Artificial revegetation.--Observations will be continued on the firebreak plots that were seeded in 1949 and 1950. New plantings for firebreak treatments will be established in 1951 in cooperation with the Industrial Lumber Company of Elizabeth, Louisiana. Four new species will be planted in the range nursery in February 1952. Periodic examinations of species growing in the nursery will be continued. A paper reporting previous results has been submitted for publication.

Brewton

An article will be written on the ecological phases of the study on forage production. It is planned to fence the Escambia Experimental Forest, and to initiate managed grazing on the area. It is also planned to conduct forest grazing studies on the new Chipola Experimental Forest on the sandy lands of west Florida.

Central Ozarks

Final (sixth-year) field measurement will be made on the 70 forage plots in the study of range forage production in upland hardwoods. An office report will also be prepared on the study of deer forage management.

Gulfcoast

Another herd of steers will be turned into the McNeill pastures. An article on 1951 results will be prepared. The half-mile big trefoil firebreak will be fertilized and observed in 1952.

New Orleans

The mimeographed instructions for forage inventories will be revised and tested on additional forest areas in east Texas and Florida.

FOREST UTILIZATION SERVICE

In 1952, cooperative work with the U. S. Forest Products Laboratory will include studies of the following subjects: strength of second-growth loblolly and shortleaf pine, cutting and drying of veneer from water tupelo and swamp blackgum, kiln-drying water tupelo and swamp blackgum, and factors affecting the specific gravity of southern pine. The Forest Utilization Service will also participate with the Laboratory in preparing the master work plan to complete the hardwood log grade study.

Cooperation is planned with the TVA in studies of seasoning, logging and milling, and wood preservation.

The study of gang sawmills will be completed in 1952. Mills in Alabama will be analyzed in cooperation with the School of Forestry of the Alabama Polytechnic Institute.

The bulletin, "Fence post barking machines in the South," will be revised to include newly developed barkers.

The cooperative study with the Forest Products Laboratory, the TVA, and the Texas Agricultural Experiment Station will continue to investigate the value of wood molasses as a food for livestock.

The Forest Utilization Service will give at least two hardwood log grade instruction courses, primarily for industrial foresters. It also plans to help in checking the pine log and tree grades that were recently formulated by a committee from the Southern and Southeastern Stations and Region 8.

FLOOD CONTROL SURVEYS

The 1952 schedule of the Division of Flood Control Surveys includes formulation and appraisal of program recommendations for the Ouachita and Lower White River watersheds to enable coordination with other agency proposals under the Arkansas-White-Red River basin study. It also involves going forward with the Hatchie-Loosahatchie-Wolf River survey; and completing forestry phases of the Red, Sabine-Neches, Coosa, and Altamaha watershed surveys of the Soil Conservation Service.

Another major item on the agenda is a watershed survey of the Cumberland River basin in Tennessee and Kentucky. This will be part of a comprehensive three-year investigation in which the Department of Agriculture and cooperating agencies will study the agricultural resources and needs of the Cumberland basin.

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PERSONNEL

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1951

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1952 ANNUAL REPORT,

Southern Forest Experiment Station

SOUTHERN FOREST EXPERIMENT STATION
Harold L. Mitchell, Director
FOREST SERVICE, U.S. DEPT. OF AGRICULTURE

The photo on the cover is of an old-field shortleaf pine stand on the Henry R. Koen Experimental Forest, near Harrison, Arkansas. The trees are 45 years old. They average 65 to 70 feet tall and range from 10 to 16 inches in d. b. h.

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During 1952 the Southern Forest Experiment Station obtained cooperative assistance having a monetary value of over $350,000. The greater part of this assistance came from State and private sources in support of research projects of mutual interest. With this aid, the Station was able to continue or strengthen most going research work, expand the Forest Survey, and inaugurate some long-delayed fundamental studies in soils, genetics, and forest influences.

The Forest Survey alone will receive during the current fiscal year $139,000 worth of cooperative assistance from the States and private industry. In Alabama, the support of the State Department of Conservation, the pulp and paper industry, and the Alabama Forest Products Association will make it possible to complete field work on the reinventory of the State in March 1953. This is two full years earlier than would have been possible with the Station's resources alone. In Louisiana, State and private agencies provided men and money to start a resurvey in 1952, three years ahead of schedule. Aid from the Texas Forest Service will make it possible to move the starting date for field work in that State from 1957 to early 1953.

Near Marianna, Florida, the new Chipola Experimental Forest is now in full operation. Financed jointly by the Station and the Florida Board of Forestry, the Chipola was set up to find ways of converting to productive stands the scrub oak forests on the deep sand sites of west Florida.

A long-term agreement with several lumber companies in Arkansas has provided funds for an investigation of soil variables correlated with the height growth of trees in southern Arkansas. The effects of prescribed burning, hardwood removal, and wet-weather logging upon soil productivity will receive special attention.

In east Texas, in cooperation with Stephen F. Austin College and the Texas National Forests, the Station has begun a study of the effects of fire on pine stocking, hardwood control, soil movement, and infiltration capacity in the rolling uplands. At the Waterways Experiment Station, Vicksburg, Mississippi, the Southern Station has continued to cooperate with the Corps of Engineers on a comprehensive program of fundamental research in the field of soil-water-cover relationships. The results of this work show promise of having wide application in forestry and flood prevention.

In 1952 the Louisiana Legislature approved a special appropriation to strengthen research at the Station's Alexandria Branch, especially in the direct seeding of pine. When reduced appropriations and inflation threatened the Station's research on the management of longleaf pine in south Alabama and north Florida, several timber owners and processors provided cooperative funds to keep the work going at the former level.

Genetics studies were started in southern Arkansas in 1952 with funds made available under a long-term cooperative agreement with the Crossett Lumber Company. A major objective is to develop strains of fast-growing, high-quality, pest-resistant, and otherwise superior trees adapted to southern Arkansas and adjacent areas. A. J. Hodges Industries, Inc., also entered into cooperative agreements with the Southern Station and other agencies to facilitate genetics research at Hodges' experimental forest near Many, Louisiana.

An outstanding example of cooperation in research is the region-wide study of geographic races of southern pines, the installation of which was largely completed during 1952. This study is sponsored by the Committee on Southern Forest Tree Improvement. The Southern Station had primary responsibility for planning and correlation. The study involves 300 private, State, and Federal cooperators in 16 States; stock will be produced in 19 nurseries and outplanted at 65 locations. There are no reliable estimates of the total cost, but it is probably the largest and most comprehensive project of its kind ever carried out in the world. It could not have been undertaken without strong cooperation.

The foregoing examples could be multiplied, but they will suffice to illustrate the cooperation the Station is currently receiving from State and private sources. Non-recurrent outlays--largely cash and manpower--for cooperation with the Station on projects of mutual interest have increased over 15-fold in the last three years. This substantial increase is due in part to the Station's efforts to stimulate greater local interest in and support for forest and range research, in line with Forest Service policy and instructions from Congress. It also reflects an increasing Nation-wide recognition of the advantages of cooperation.

A decade ago, for the Nation as a whole, only about a fourth of the non-Federal outlays for forest and range research were for cooperative projects. Today over half of the much greater non-Federal expenditures are for research carried on in direct cooperation or close coordination with that of the U. S. Forest Service. In the South, over 75 percent of the non-Federal outlays are for cooperative research, and the trend is for greater rather than less cooperation between the Federal government and State and private organizations.

Total non-Federal expenditures for forest and range research, cooperative and otherwise, are also on the increase. Here again, the South is making a bid for leadership. For the three-year period 1949-1952, non-Federal outlays for forest and range management research in the South increased 55 percent, as compared with an increase of 37 percent for the Nation as a whole. These figures are based on expenditures for salaries and operating expenses, and do not include the substantial investments in land and permanent improvements at research installations.

In the aggregate, cooperative aid received by the Southern Station in 1952 more than compensated for recent reductions in Federal appropriations and the effects of inflation. However, not all areas and lines of work fared equally well. A number of the Station's research centers, serving important timber-producing areas, are currently functioning on a bare maintenance basis for lack of operating funds. And in certain important lines of work, such as research in forest influences and tree physiology, there is little likelihood of industrial interest or support. Such research seems destined to remain largely a public responsibility, with little hope of financial assistance from private sources.

At this stage in our expanding cooperative program, it would also be appropriate to introduce a word of caution regarding the future. Forestry is a long-term proposition, and accordingly most research in this field must be long-term in character. Forest research cannot be started up one year and dropped the next without prohibitive sacrifice of time, investment, and results. To be really effective, it must have continuity, with each study sustained without interruption for the entire period required to produce conclusive results. The possibility of ups and downs in cooperative aid is an ever-present danger which must be recognized and guarded against.

Another point that should be considered in connection with cooperative research is the importance of maintaining at the Southern Station an adequate cadre of competent researchers ready and able to take full advantage of opportunities for joint action with the States and private industry. Our recent experience in expanding the Forest Survey is a good example of how a nucleus of experienced technicians can train new personnel, plan, organize, and efficiently carry out a major research job on short notice. In this case, the number of field crews was increased from 2 to a high of over 25 in a few months, with work going on simultaneously in three States. The speed-up was accomplished without adding a single technical man to the Forest Survey overhead organization, and with no sacrifice in accuracy of results. The region-wide cooperative seed-source study was similarly planned and coodinated with no increase in Station personnel.

As indicated above, there are certain dangers in financing the needed expansion of the Station's research program largely with cooperative funds. However, on the basis of the Station's experience to date, it appears that the advantages far outweigh the disadvantages, most of which can be overcome with careful planning, long-term agreements, and maintenance of an adequate Federal base. We interpret the progress made in this direction during the year as a strong and healthy trend away from too much dependence on the Federal government and toward greater participation and financial support by the local industries, the States, and other agencies which stand to benefit most from the results of cooperative research.

Next year we shall continue to work aggressively for greater cooperation and for stronger support for forest and range research at the Southern Station, the forest schools, and State Experiment Stations in our territory. Research must be strengthened, through cooperation or otherwise, to provide answers to current problems and the new problems sure to arise as forest and range management become more and more intensive and widespread throughout the South.

RESULTS

FOREST MANAGEMENT
(including Forest Influences)

Regeneration

Sweetgum seed flight

Sweetgum seed does not travel as far from the parent tree as many people believe. In south Arkansas, twenty-five lots of sweetgum seed (about 20,000 seed per lot) were dropped from a fire tower at heights ranging from 33 to 100 feet. Of the seed that was recovered, 96 percent was within 200 feet of the tower and most of the remaining 4 percent was trapped between 200 and 400 feet. The longest flight of any seed that was recovered was 600 feet. The test area was level, open prairie. Wind velocities were 5 to 25 miles per hour.

These findings have at least two practical applications. Where hardwood control measures are being carried on to favor the pine component of pine-hardwood stands, all seed-bearing sweetgum should be eliminated from the stand and in a border zone of 600 feet. On the other hand, where a regeneration cut is being made in sweetgum stands on a good hardwood site, sweetgum seed trees should be spaced not much farther apart than 100 feet. These recommendations take into account the fact that forests reduce wind velocity and impede seed travel more than do open sites.

Longleaf seed production in south Mississippi

Cone production records of longleaf pine seed trees on the Harrison Experimental Forest indicate that site quality influences the cone crop. Over a six-year period, seed trees growing on a moderately good site have averaged 178 cones per tree per year. During the same period the average for seed trees on a harsh sand-hill site has been 85 cones. While the trees on the good site consistently produced more cones--and hence more seed--than those on the poor site, there has been considerable variation between trees on the same site and from year to year on the same tree. No appreciable differences were noted between the two sites in average total weight of seed per cone, number of seed per cone, average weight of individual seeds, germination, or field performance.

Sawdust as a nursery soil amendment in south Mississippi

When sawdust is used with fertilizer as an amendment to nursery soils, does the sawdust contribute anything directly to the life processes of the seedlings or do its benefits stem solely from its mechanical action on the soil?

This problem has been investigated at the Harrison Experimental Forest. The field performance of longleaf pine seedlings from a sawdust-amended nursery soil was compared with that of seedlings raised in a nursery soil amended with an inert substance--in this case, vermiculite. Each of the two substances was tested at rates of 75, 150, and 300 cubic yards per acre. The soils to which these amendments were applied also received a pre-sowing application of 20 percent superphosphate at a rate equivalent to 4,000 pounds per acre and 50 percent muriate of potash at a rate equivalent to 600 pounds per acre. In addition, the sawdust-treated soils received a post-sowing application of enough ammonium nitrate to counteract the extra nitrogen requirements imposed by decomposition of the sawdust.

Second-year survival of outplanted longleaf pine seedlings shows no advantage of the sawdust. In fact, the reverse seems to be true (table 1)--seedlings grown with vermiculite showed the best survival. In general, the field survival increased as the rate of soil amendment increased.

Table 1.--Second-year survival of planted longleaf pine from amended nursery soils

Amount of amendment applied (cubic yards per acre)	Pine survival from soils amended with: Sawdust	Vermiculite
	Percent	
75	63	65
150	67	81
300	75	77
Average	68	74

When the first crop of seedlings had been lifted, another was grown on the same nursery beds without retreatment with sawdust and vermiculite. One year after this second crop of seedlings was outplanted, no significant survival difference attributable to residual effects of previous nursery bed treatments could be detected.

Seedbed density affects longleaf height growth

Large longleaf pine nursery stock produced by maintaining low seedbed densities will start height growth faster than smaller stock grown at higher densities.

In south Mississippi, seedlings were grown at four different seedbed densities and were outplanted on a moderately severe site. They were sprayed with Bordeaux mixture whenever brown-spot control became necessary. The growth of the seedlings in the two years since planting is shown in Table 2.

In another phase of this study seedlings were planted in an old field. Seedlings grown at an average seedbed density of 59 per square foot averaged only 2.6 inches in height after two years in the field, and only 32 percent of the original number planted had attained a height exceeding 2-1/2 inches. Seedlings grown at an average density of 31 per square foot averaged 4.6 inches in height, and 58 percent of the original number planted had started height growth in 2 years. Extra large

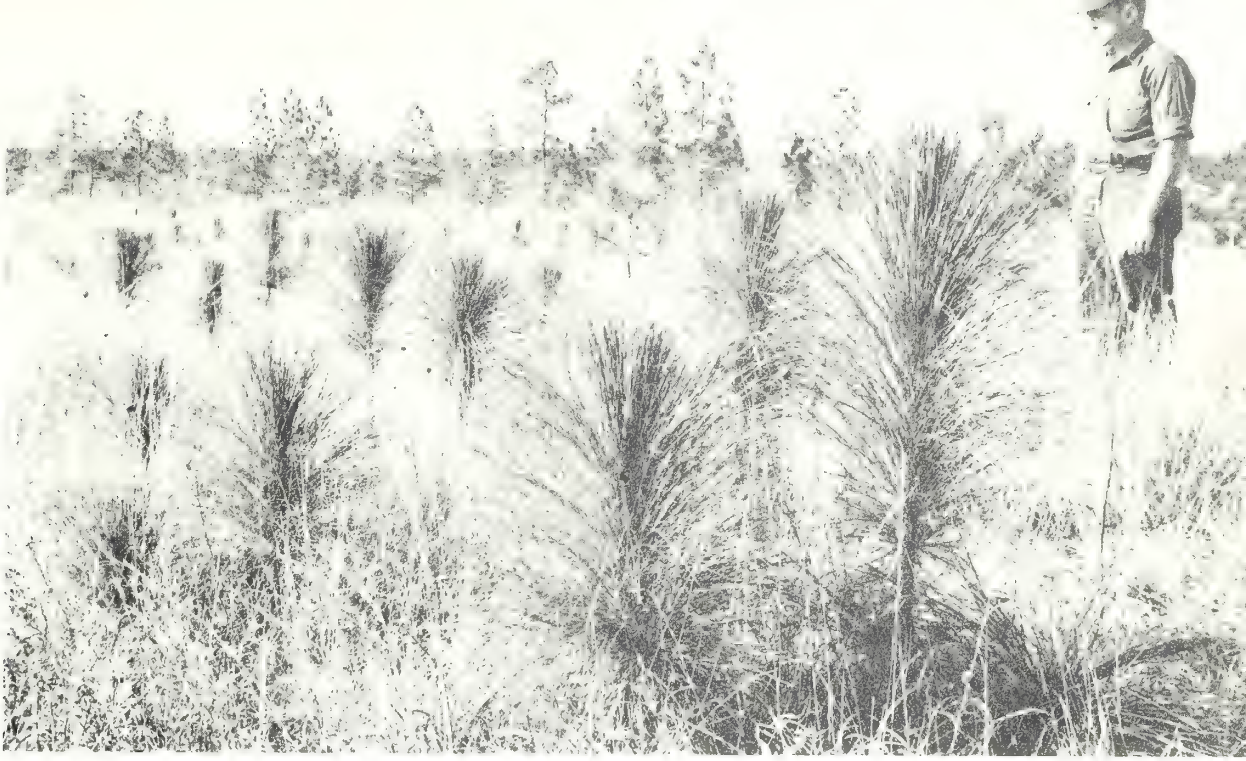


Figure 1.--Five years ago (in November 1947) this stretch of cut-over longleaf pine land in central Louisiana was disked and sown with three pounds of longleaf seed per acre. The Southern Station's success with direct seeding has encouraged many private landowners to undertake this method of reforestation. (Photo by Louisiana Forestry Commission)

seedlings from beds with an average density of 12 per square foot had an average height of 6.2 inches, and 79 percent had started height growth. These seedlings were grown in a good nursery soil which had been well fertilized. On poorer nursery soils with minimum fertilization, reduction of seedbed density has not stimulated seedling growth in the nursery as much as in this test.

Table 2.--Longleaf seedling development two years after planting

Seedbed density (no. seedlings per sq. ft.)	Wt. of seedlings when lifted	Proportion of planted pines over 2.5 inches tall	Av. ht. of living seedlings
	Grams	Percent	Inches
12	29	73	4.8
22	20	54	3.3
33	15	29	2.6
42	11	22	2.3

Direct seeding of longleaf pine in central Louisiana

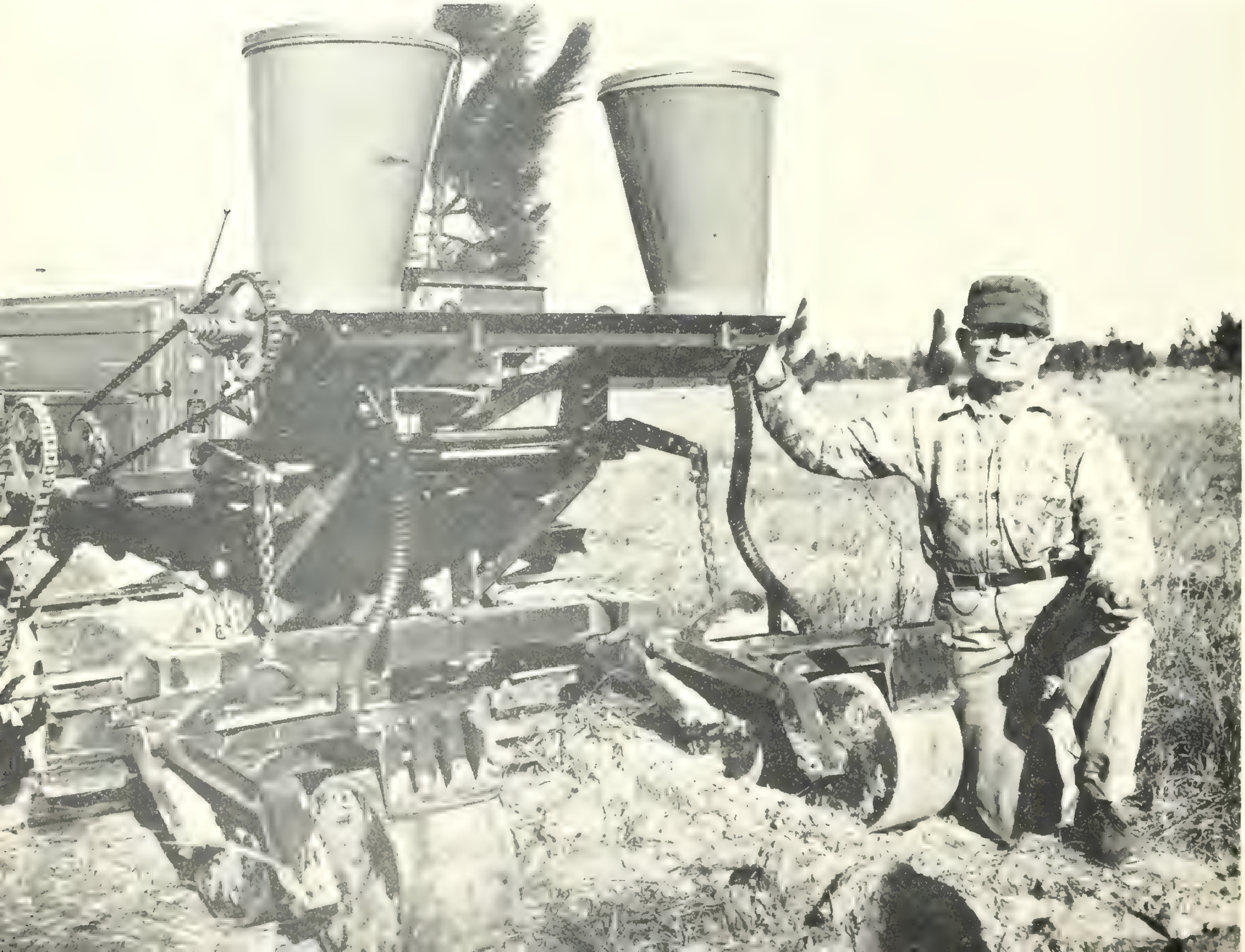
Large-scale tests of direct seeding of longleaf pine are being continued in central Louisiana (fig. 1). On four areas totalling 602 acres, an average initial catch of 2,127 seedlings per acre was obtained by sowing at a rate of 3 pounds of seed per acre in the fall of 1951. However, there was a wide variation in the seedling stands over the area, largely because of differences in bird activity during the germination period.

Mortality of seedlings during the first summer averaged 40 percent. Greatest mortality was on a dry, sandy tract, where 75 percent of the seedlings died. On areas having better soil moisture conditions, mortality was 25 percent. Summer rainfall during the first year was more than 10 inches below normal. Despite drought losses, however, there remained in November 1952 an average of over 1,000 seedlings per acre.

Modified corn planter for seeding longleaf pine in Louisiana

Two corn planters, modified as shown in figure 2, have been used experimentally by Crosby Chemicals, Inc., for direct seeding of

Figure 2.--Modified corn planter being used by Crosby Chemicals, Inc., for seeding longleaf pine near Pitkin, Louisiana. With the machine is the company's mechanic, Harvey M. Rogers, who helped develop the planter. (Photo by Louisiana Forestry Commission)



longleaf pine on 900 acres in west-central Louisiana. The Southern Forest Experiment Station is cooperating in the project.

Strips 8 feet wide and 8 feet apart were double-disked during the summer and seeded in November and early December. The corn planters, which were mounted behind light crawler tractors, dropped the seeds about 12 inches apart in the tractor tracks and pressed them down with rollers. Seed was sowed at a rate of 1.75 pounds (about 9,000 seeds) per acre.

Effects of wildfire on direct-seeded longleaf in central Louisiana

Longleaf reproduction produced by direct seeding during the winter of 1948-1949 has withstood two wildfires with a loss of only 2 percent. The first fire occurred in January 1951 when the seedlings were 2 years old; the second was in January 1952 when the seedlings were 3 years old. Both fires were slow-burning. By October 1952, 32 percent of the surviving seedlings had started height growth.

From these and other observations it appears that, with or without fire, direct-seeded longleaf suffers its heaviest mortality during the first year. Seedlings that survive the first year can be expected to survive and develop at least as well as planted stock.

Direct seeding of loblolly pine in central Louisiana

Disking prior to sowing of one pound of stratified seed per acre has given good first-year results in tests of direct seeding of loblolly pine in central Louisiana. On areas with a heavy grass rough, burning prior to disking improved the seedling catch. The seeding was done in March 1952.

Disking appears necessary for best results. Direct seeding on either a light rough without any site preparation or on a heavy rough that had been freshly burned gave good catches and fair first-year survival, but many of the living seedlings are now smothered by rank grass and are so small that their survival is doubtful.

Stratification (in moist sand at 34° F.) caused the seed to germinate much quicker than did untreated seed and thereby reduced losses to birds and rodents. It also increased the germination percent and caused the bulk of the seeds to germinate at about the same time.

Seedling catch and first-year survival for the various seed and site treatments are shown in table 3.

Table 3.--Initial catch and first-year survival of loblolly direct-seeded in March 1952

Site preparation	Seed treatment	Seedlings per acre	
		June 1952	November 1952
		Number	
Heavy rough			
No preparation	Stratified	518	259
	Unstratified	111	39
Burned	Stratified	1,704	333
	Unstratified	2,407	1,000
Disked	Stratified	1,556	741
	Unstratified	278	0
Burned and disked	Stratified	2,333	1,185
	Unstratified	1,334	963
Light rough			
No preparation	Stratified	3,666	2,112
	Unstratified	3,000	333
Disked	Stratified	7,555	4,296
	Unstratified	2,333	1,482

Direct seeding of loblolly pine in south Arkansas

At Crossett, Arkansas, sowing one pound of untreated seed on a fresh burn in November has for the second time proved to be a successful method of direct-seeding loblolly pine on areas dominated by inferior hardwoods. In each case the hardwoods (which ranged from 2 to 20 inches in diameter) were girdled prior to the time the seed would normally germinate. Five acres treated in this way produced an average of 3,700 well-distributed seedlings per acre at the end of the first growing season. Sowing one pound of untreated seed in November on unburned areas produced at least 1,000 seedlings per acre.

South-wide tests of clipping and dipping

Extensive tests have confirmed the beneficial effects of foliage clipping on the early survival of planted longleaf pine seedlings. Clipping has increased early survival by 10 to 20 percent in a number of widely scattered test plantings. Dipping the seedling tops in Dowax has often been equally beneficial, but the results have not been consistent.

These conclusions are from a study being made by the Gulfcoast Branch of the Southern Forest Experiment Station in cooperation with Region 8, U. S. Forest Service. Experimental stock was planted on the Ocala, Apalachicola, Conecuh, and Kisatchie National Forests in 1951 and on these plus the DeSoto in 1952. The treatments were: Clipping needles to 5 inches and dipping needles in a wax emulsion (1:3 concentration of Dowax). Some seedlings were both clipped and dipped. The results of these tests are summarized by year of planting and treatment in table 4.

Table 4.--Effect of foliage treatments on average survival of longleaf pine seedlings

Seedling treatment	1951 planting: survival 1-1/2 months after planting	1952 planting: survival at--	
		1-1/2 months after planting	9 months after planting
	- - - - -	Percent	- - - - - - - -
Untreated control	30	74	28
Clipped, not dipped	50	90	46
Dipped, not clipped	48	90	42
Dipped and clipped	56	93	46

In each year clipping increased early survival on each forest. Dipped seedlings survived better than untreated seedlings except in the 1951 planting on the Conecuh. This exception indicates that under certain as yet undetermined conditions wax foliage coatings may be harmful; they should therefore only be used on an experimental basis.

Clipping longleaf needles to 5 inches at the nursery is recommended as a standard practice (fig. 3). It must be realized, however, that clipping by itself cannot guarantee good survival. On very dry sites or in extremely dry years survival may be poor regardless of foliage treatment. Clipped seedlings can, however, be expected to give considerably better initial survival than unclipped seedlings planted under the same conditions.

Foliage treatment of large longleaf pine seedlings in central Louisiana

Large longleaf pine seedlings normally start height growth more quickly after planting than do smaller seedlings, but the survival of large seedlings is often low. In the spring of 1952 a test was installed near Alexandria, Louisiana, to determine if the field survival

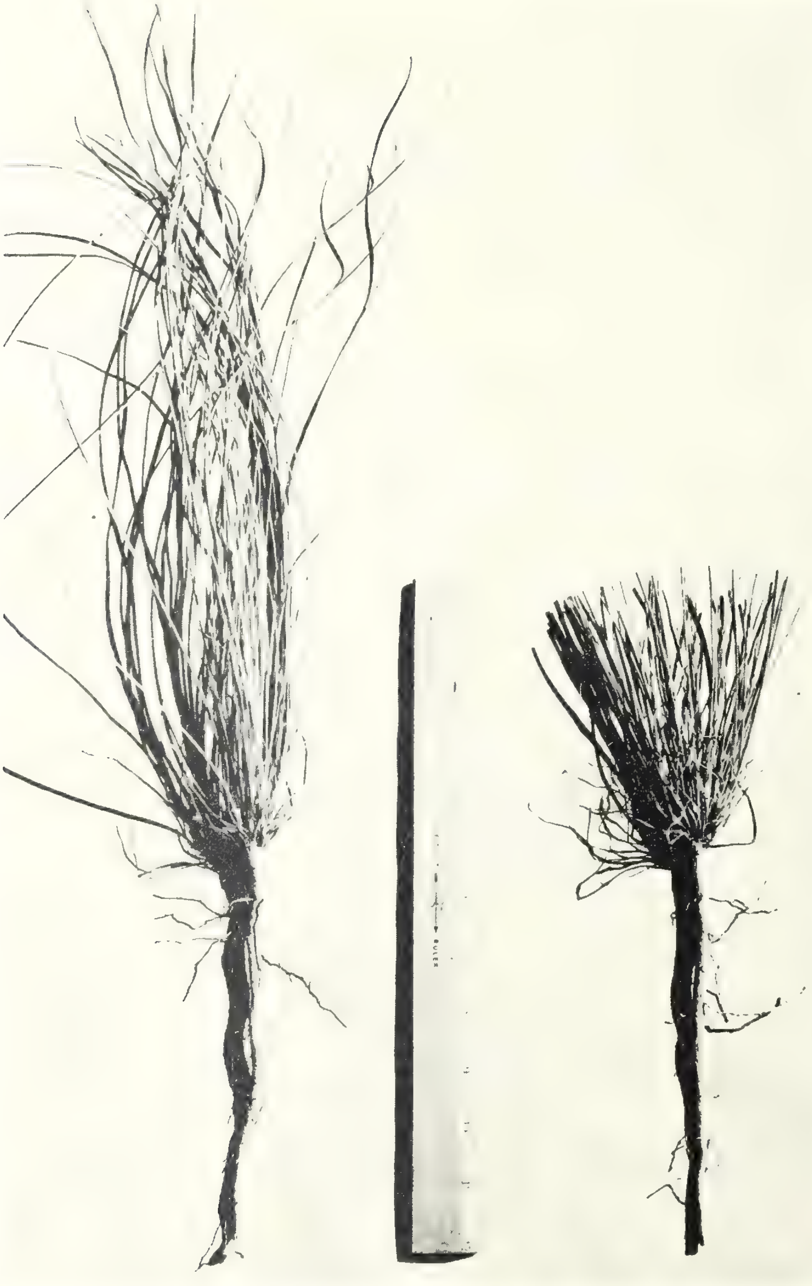


Figure 3.--Clipping the foliage of longleaf seedlings before planting has been found to increase first-year survival 10 to 20 percent. The Southern Forest Experiment Station advocates that all longleaf planting stock be so treated in the future. Left: Unclipped seedling. Right: Foliage clipped to recommended length of five inches. Both seedlings have had their tap roots pruned to about 7 inches in accordance with standard nursery practice.

of large longleaf seedlings could be increased by clipping and dipping the needles.

Bed-run seedlings were first classed as either large (over 1/2 inch in diameter at the root collar) or average (less than 1/2 inch in diameter at the root collar) in size. Half of the seedlings in each group were then treated by clipping 50 to 60 percent of the live foliage and dipping the tops into a D-wax emulsion. The remaining seedlings were neither clipped nor dipped. Half of the seedlings in each foliage treatment and size class combination were planted on a heavy soil with a one-year-old grass rough and the other half on a similar site that had been recently burned. The survival percentages four months after planting are shown in Table 5.

Table 5.--Survival of clipped and dipped longleaf seedlings, four months after planting

Size and treatment of seedlings	Planting site: 1-year rough	Planting site: Fresh burn
	- - Percent -	
Average seedlings		
Clipped and dipped	81	68
Untreated	72	63
Large seedlings		
Clipped and dipped	43	52
Untreated	35	20

Average-size seedlings survived distinctly better than large seedlings regardless of treatment or site. Clipping and dipping improved survival of both large and average seedlings regardless of site. Survival was generally better in the one-year rough.

Storage of clipped and dipped longleaf seedlings

Clipped and dipped longleaf seedlings are apparently able to survive storage as well as untreated seedlings. Seedlings that had been clipped to the recommended foliar length of 5 inches, seedlings that had been dipped in Dowax emulsion, and seedlings that had been both clipped and dipped were stored in regular shipping bales for 1, 3, 7, and 15 days before planting. Untreated seedlings were stored for the same lengths of time. Survival was tallied four months after the seedlings were planted.

Fifteen days' storage reduced the survival of all foliar-treated seedlings from 77 percent (average for 1, 3, and 7 days' storage) to 55 percent. It reduced the survival of baled check seedlings from 60 percent to 40 percent. Differences in survival among the three foliar treatments were not significant.

The average survival of all seedlings stored for 1, 3, and 7 days was 77, 74, and 72 percent respectively. Storage for 15 days dropped the over-all average survival to 52 percent.

Fire resistance of planted longleaf pine in south Mississippi

Fire resistance of longleaf seedlings more than three years old is determined by seedling size and severity of brown-spot defoliation. In January 1951 a 3-year-old longleaf plantation on a low, sandy ridge in south Mississippi was burned by a wildfire of moderate intensity. A survival count made 1-1/2 years later showed 56 percent of the 1,570 burned seedlings still alive. Seedlings between 0.6 and 2.4 feet in height suffered the heaviest loss from fire. In all height classes, seedlings which had been more severely defoliated by brown spot a year before the fire seemed less resistant than lightly infected seedlings. Results of the survival count are summarized in table 6.

Table 6.--Survival of burned longleaf seedlings

Height class 1951 (feet)	1950 brown-spot defoliation				Average
	0-35 percent	40-65 percent	70-95 percent	100 percent	
	- - - - - - Survival percent	- - - - - - - -			
0-0.5	75	74	55	37	61
0.6-2.4	70	48	22	7	34
2.5+	100	91	100	...	98
Average	74	70	49	27	56

Planted black locust and osage orange in south Mississippi

Black locust and osage orange plantings made on an old field in south Mississippi have not proved very successful. Common black locust on plots cultivated and fertilized during the first year averaged 8.8 feet in height at the end of one year and 15.2 feet in height after 4-1/2 years. A similar planting a year later had a first-year height of 7.1 feet. After 3-1/2 years, however, it was only 7.6 feet in height, largely because many tops are dying back each year. In the first set of plantings neither cultivation nor fertilization alone produced as good growth as a combination of these treatments. Shipmast locust (Kimberly and Higbee strains) made a poorer showing than did common locust.

These results indicate that one year of cultural treatment will not compensate for differences in soil and climate out of the natural range of black locust. Although it might be possible to get better growth in south Mississippi by annual treatments, the expense probably would be prohibitive.

Osage orange was even less impressive than black locust; it grew very little in the first year and then quit growing altogether.

Pond pine test-planted in south Mississippi

Reforestation of wet or "pitcher plant" meadows is often difficult in south Mississippi. Slash pine planted on these areas often makes fairly good growth for the first several years and then slows down. Small plots have been planted on the Harrison Experimental Forest to see whether pond pine (Pinus rigida var. serotina) would survive and grow on these wet areas in Mississippi, which is outside its natural range. Slash pine was also planted to give a standard of comparison.

At the end of the first year in the field, pond pine had a survival of 93 percent, and the surviving seedlings averaged 0.9 foot in height. Slash pine had a survival of 96 percent and averaged 1.4 feet in height. The slight superiority of slash pine has little significance, since last summer was drier than average.

Pine planting on the sand hills of west Florida

A planting study to compare the suitability of five southern pines to west Florida's scrub-oak sand hills, and to evaluate the effect of releasing these plantings from competing scrub hardwoods, was established in January 1952. The pines being tested are longleaf, slash, loblolly, sand, and shortleaf. One-fifth of the trees of each species were released immediately after planting.

With the exception of longleaf, first-year survival of the pines has been very encouraging. Despite one of the worst droughts in years, 70 percent of the slash pine survived. Survival of sand pine was 62 percent, loblolly 54 percent, and shortleaf 40 percent. The longleaf stock was dry and chlorotic, and turned brown shortly after planting.

To date, no conclusive effects of release have been observed. There has been some indication that killing only the woody vegetation is not enough. In this area of extreme moisture deficiency, the root competition produced by herbaceous vegetation may seriously reduce the survival of newly planted pine seedlings. This point will be investigated in a new study comparing the effect on pine survival of several degrees of pre-planting site preparation. The intensity of site preparation will vary from a prescribed burn to the complete elimination of competition by bulldozing (see fig. 4).

Mixed pine and redcedar planting in north Mississippi

Plots of eastern redcedar, shortleaf and loblolly pine, and mixtures of each pine species with redcedar were established in north Mississippi in 1950 to compare the growth and development of these species in pure and mixed plantations.

Figure 4.--Making a new "old field." The most extreme method of pre-planting site preparation being tested in the west Florida sandhills project.

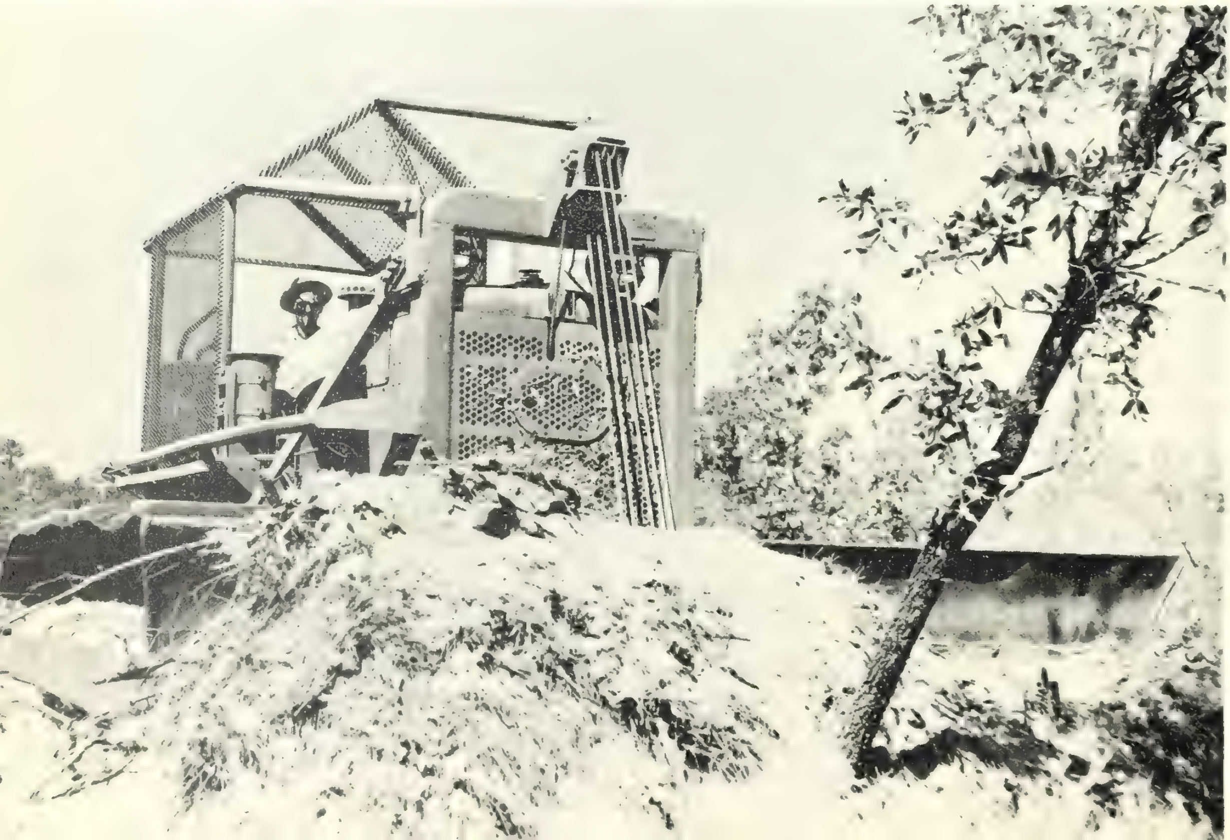


Table 7.--Third-year survival of pure and mixed pine and redcedar plantations in north Mississippi

Species	Pure	Mixed
	- Percent -	
Shortleaf	64	51
Loblolly	46	59
Redcedar	61	...
with shortleaf	...	42
with loblolly	...	59

After three growing seasons, there are no appreciable differences in survival, growth, or degree of insect attack between the pure and mixed plantings. As table 7 shows, survival has been poor regardless of species or type of planting. Insect attack is evenly spread over both pure and mixed plantations. Pine tip moth (Rhyacionia frustrana) infested 92 percent of the shortleaf and 97 percent of the loblolly pine. Pine webworm (Tetralopha robustella) attack was negligible, occurring on only two percent of the shortleaf and one percent of the loblolly. Deer browsing damage to redcedar has been greater on the pure than on the mixed plantations.

Underplanting with loblolly pine and yellow-poplar in north Alabama

Yellow-poplar seedlings planted under less desirable hardwoods must be released for satisfactory survival and growth. After 5 years, yellow-poplar underplanted on areas on which all undesirable hardwoods over 1-1/2 inches d. b. h. were cut had a survival of 79 percent and a height of 8. 1 feet. On areas where undesirable hardwoods over 5-1/2 inches d. b. h. were cut, the underplanted seedlings survived 84 percent and reached a height of 5. 6 feet. On unreleased check plots, survival was only 51 percent and total height 1. 8 feet. Figure 5 shows released and non-released yellow-poplars 3 years after planting.

Underplanted loblolly pine had a survival after 5 years of 53 percent and an average height of 5. 3 feet on areas receiving deferred or immediate release of various degrees. On unreleased check areas, the survival was 64 percent and height 2. 6 feet. Even with release, the survival and growth of the pines have not been good. The poor showing of the pines has been partly due to the presence of small understory hardwoods which, of course, also responded to reduction of overstory competition. In such situations, control of understory as well as overstory hardwoods will probably be necessary.

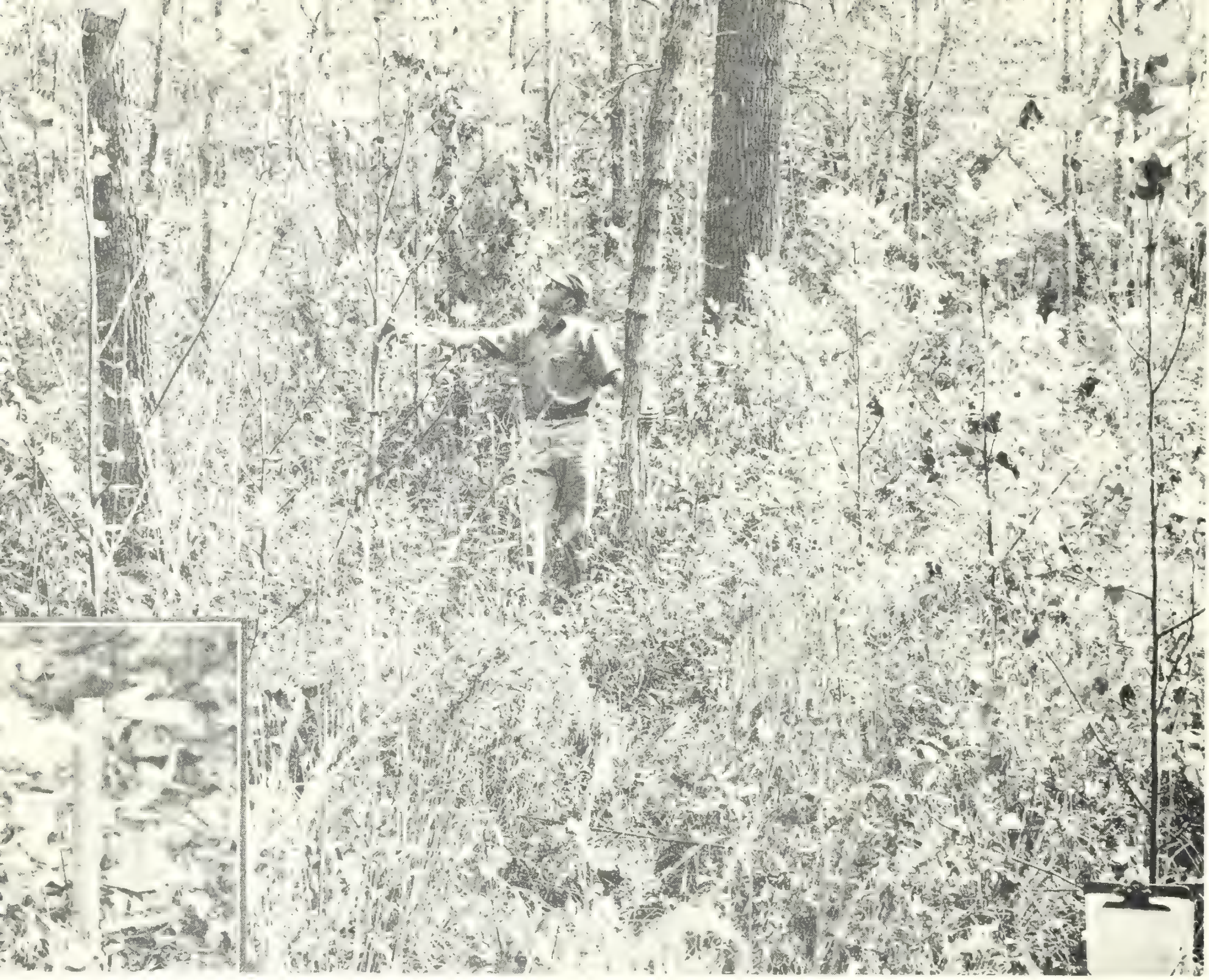


Figure 5. --Underplanted yellow-poplar must be released from overtopping inferior trees. Large photo shows three-year-old yellow-poplars on an upper slope in north Mississippi; these trees were released at planting time. Inset: Three-year-old non-released yellow-poplar on an upper slope in north Alabama.

Underplanting with hardwoods and loblolly pine in north Mississippi

After four growing seasons, released seedlings of underplanted white ash, white oak, yellow-poplar, black locust, and loblolly pine average two to six times the height of unreleased seedlings and also show better survival. Of the six species tested, only black walnut on dry middle and upper slopes has failed to show better growth when released. Survival of all species on all sites averages 67 percent for released seedlings and 52 percent for unreleased. For yellow-poplar, probably the most promising species, the difference is even greater--73 percent with release and 39 percent without. The greatest benefit of release, however, is expressed in the increased height growth (table 8).

Table 8.--Average fourth-year heights of underplanted seedlings in north Mississippi

Site and treatment	White ash	Black walnut	White oak	Yellow-poplar	Black locust	Loblolly pine
	Inches					
Upper and middle slopes						
Released	37	23	23	83	90	87
Unreleased	12	25	14	20	23	27
Lower slopes and minor bottoms						
Released	42	63	23	109	110	74
Unreleased	12	30	14	25	17	19

The need for release is greatest on the more fertile and moist lower slopes and minor bottoms, where competition is most vigorous. On the poorer upper slopes, release increased average second-year survival from 71 to 79 percent. On the good site of minor bottoms, release increased survival from 53 percent to 70 percent.

Underplanting with conifers in north Mississippi

The results of four years of underplanting low-grade upland hardwoods with six conifers in north Mississippi provide additional evidence of the need for release when underplanting. After four growing seasons, the released seedlings averaged more than twice the height of those unreleased (table 9).

Table 9.--Average height of four-year-old conifers planted under a hardwood overstory in north Mississippi

Treatment	Loblolly pine	Shortleaf pine	Virginia pine	Slash pine	Longleaf pine	Eastern redcedar
	Inches					
Released	73	42	67	61	11	21
Unreleased	35	18	34	23	.4	9

First-year survival of all species combined, based on plantings made during each of four consecutive years, averaged 68 percent for released seedlings and 63 percent for unreleased. About half of the first-year mortality of released seedlings occurred during May and June. Unreleased seedlings had lower mortality during this period, about one-third of the first-year total, but suffered heavier losses during the drier months following June.

Severe drought during the summer of 1952 provided an opportunity to compare mortality, under adverse conditions, of well-established plantations with that of new plantations. Mortality of well-established four-year-old seedlings was 7 percent for released trees and 5 percent for unreleased. The younger the plantations, the greater was the mortality--first-year seedlings suffered five times more loss than four-year-olds. Losses in 1952 among first-year seedlings were 40 percent for released seedlings and 47 percent for non-released seedlings.

Average pine tip-moth infestation on released seedlings (exclusive of redcedar and longleaf pine) increased from 29 percent the first year to 63 percent the second year; on unreleased seedlings it increased from 3 to 19 percent. Pine webworm attack decreased on released plantations from 19 to 7 percent, but increased in those unreleased from 13 to 20 percent.

Genetics

Geographic seed sources of loblolly pine for planting in north Arkansas

Because of the danger of winter damage, loblolly pine is at best a risky species for planting in the Arkansas Ozarks. However, two-year results of a test of geographic seed sources indicate that the risk may be reduced by planting stock grown from seed collected in areas having an average growing season of less than 210 days. On the average, less than 8 percent of the stock from such sources was damaged during the severe cold snap of November 1951. About 36 percent of the stock grown from seed collected in areas having a growing season of more than 210 days was damaged.

Length of growing season, percent of trees damaged, and two-year height growth for the various seed sources are shown in table 10.

South-wide test of geographic seed sources

An investigation of the existence and distribution of geographic races of the four major southern pines is under way. Outplanting of 370 separate lots of stock at 57 different locations by 23 cooperators is now in progress. This study, one phase of the work of the Committee on Southern Forest Tree Improvement, is being supervised and coordinated by the Southern Forest Experiment Station.

Table 10.--Winter damage and height growth of loblolly pine in the Ozarks

Seed source	Length of growing season	Percent of trees damaged	Two-year height increment
	Days	Percent	Feet
Maryland	210-	0	1.5
North Alabama	210-	7	2.8
Southeast Tennessee	210-	11	2.4
Virginia	210-	12	2.1
North Georgia	210+	19	2.7
East Mississippi	210+	43	2.2
North Mississippi	210+	43	2.2
South Alabama	210+	44	2.3

Seed for this study was collected by 25 private, State, and Federal agencies. The planting stock was grown by 19 cooperating forest tree nurseries. Despite the abundant opportunities for mishaps, the work has suffered only a few minor setbacks. Cooperators have given freelyof time, money, and energy, in most cases far beyond the hoped-for minimum.

Pine hybridization in central Louisiana and south Mississippi

Fifteen hundred hybrid seeds have been obtained from the following controlled pollinations made in the spring of 1951:

Research center	Female parent	Male parent or parents
Alexandria, La.	*Pinus echinata*	*P. elliottii elliottii*; *P. elliottii densa*; *P. taeda*
Gulfport, Miss.	*P. elliottii elliottii*	*P. elliottii densa*; *P. echinata*
Gulfport, Miss.	*P. taeda*	*P. elliottii densa*; *P. palustris*

These seeds will be sown in 1953 to test their viability and hybridity. Wind-pollinated seeds from the same female parent trees will be planted as checks.

Difficulties experienced with pollen storage, pollination bags, and attacks by insects on yearling cones made it impossible to judge the effectiveness of several other attempted crosses of southern pines. At Gulfport, Mississippi, insects destroyed every cone of P. palustris pollinated under controlled conditions.

Female strobili of two P. palustris trees were pollinated with P. elliottii elliottii and those of a third with P. taeda pollen, without bagging. Seeds obtained from the resulting cones will be sown in 1953 to see whether they yield hybrid as well as longleaf seedlings.

Hybrid pine performance in north Mississippi

After four growing seasons, two backcross hybrids of loblolly and shortleaf pine planted near Oxford, Mississippi, have failed to display any superiority over native stock of their respective parent species. The hybrids, produced by the Institute of Forest Genetics at Placerville, California, are the result of backcrossing a loblolly x shortleaf hybrid with each of the parent species.

The average third-year survival and fourth-year height of the hybrids and parent species are shown in table 11. The backcross of the hybrid to loblolly pine is here designated as the loblolly hybrid, the backcross of the hybrid to shortleaf pine as the shortleaf hybrid.

Table 11.--Comparative performance of hybrids and parent species

Species	Average third-year survival	Average fourth-year height
	Percent	Inches
Loblolly pine	81	59
Loblolly hybrid	85	54
Shortleaf pine	91	45
Shortleaf hybrid	74	35

This test must be considered exploratory, since the parent trees of the hybrids were not of the same seed source as the parent trees of the native stock.

Loblolly-shortleaf regeneration cuttings in south Arkansas

Near Crossett, Arkansas, four different regeneration cutting methods have given about equally good loblolly-shortleaf pine restocking where ample seed was available and undesirable hardwoods were controlled. Results of a 1952 inventory of two series of plots, the first cut in 1937 and the second in 1942, are shown in table 12.

Table 12.--Loblolly-shortleaf pine restocking in 1952 under four cutting treatments applied in south Arkansas in 1937 and 1942

Cutting method	Area with pine over 3.5 inches d.b.h.	Area with pine of any size	Average number of pine per acre smaller than 3.5 inches d.b.h.
	- - - Percent	- -	Number
Cut to 6.5 inches d.b.h.	15.3	83.7	2,470
Cut to 11.5 inches d.b.h.	27.0	87.3	3,205
Seed-tree	27.0	93.6	3,845
Selection (cut each 5 years)	50.5	85.8	2,903

In all cases pine reproduction (trees under 3.5 inches d.b.h.) is now present in more than adequate numbers, and large or small pines are well distributed over the area. Elimination of hardwoods over 3.5 inches provided adequate release of the new seedlings. Less intensive release did not ensure good survival of the pine reproduction.

Longleaf pine regeneration cutting in south Alabama

In a study near Brewton, Alabama, the volume cut per acre in young second-growth longleaf pine stands did not affect logging costs greatly. This not unexpected result corroborates observations made elsewhere that a light cut involving principally the larger trees costs little more per MBM than does a heavy cut which involves numerous smaller and relatively more expensive trees. As a byproduct of a test of longleaf management systems, it was found that costs per MBM where all but a few seed trees were cut did not differ much from costs where only a few trees were removed in a light improvement cut.

The actual dollar costs for logging (F. O. B. sawmill, treating plant, or railroad car) over a 4-year period, are shown in table 13.

Table 13.--Logging costs in second-growth longleaf pine in south Alabama

Type of harvest	Sawlogs		Poles		Pulpwood	
	Volume cut per acre	Cost per MBM	Cut per acre	Cost per pole	Volume cut per acre	Cost per cord
	Bd. ft. (Doyle)	Dollars	No.	Dollars	Cords	Dollars
Light cut	370	18.04	2.3	1.36	1.2	6.39
Heavy cut	532	18.26	14.7	1.18	4.4	6.15

From a silvicultural point of view, of course, heavy cutting of longleaf overstory must be conducted whenever reproduction is desired, regardless of logging costs. On the study areas most of the advance reproduction arose from the good seed crop of 1947. Since heavy cutting on the above areas occurred in 1948, 1949, 1950, and 1951, the seedlings were suppressed for one to four years. More than two years' delay in release has proved quite costly, as table 14 shows.

Table 14.--Distribution and size of longleaf seedlings in south Alabama released at varying intervals after 1947 seedfall

Time between 1947 seed fall and overstory removal (years)	Proportion of mil-acres stocked in fall 1952 with 1947 seedlings	Root-collar diameter of 1947 seedlings in fall of 1952
	Percent	Inches
1	83	0.67
2	76	.57
3	35	.44
4	52	.39

The trends in table 14 were corroborated by another longleaf seedling study in south Alabama in which release was accomplished by deadening a scrub-oak overstory at various times after seedling germination.

Shortleaf-loblolly pine regeneration cutting in east Texas

The exceptional shortleaf pine seed crop that east Texas experienced in 1951 has been an object of interest from date of seedfall through first-year establishment. Despite the heavy loss attributable to the severe drought of 1952,some interesting observations have been made.

Various regeneration cuts made on the Stephen F. Austin Experimental Forest in 1949, 1950, and 1951 affected both magnitude of 1951 seedfall and ultimate seedling establishment in 1952. Forty-eight quarter-milacre seed traps placed on selection, clear-cut, and shelterwood cutting plots caught 14,401 pine seeds (mostly shortleaf) from October 15, 1951, to June 10, 1952. This is a great increase over the 34 seeds caught in the same traps the previous year. The seedfall was 541 thousand per acre on strip clear-cuttings, 1, 120 thousand on selection cuttings, and 1, 939 thousand on shelterwood cuttings.

Periodic germination tests of the seeds falling on all traps showed that gross germination decreased from 70 percent in early November to 27 percent in the following May. This reduction is principally attributable to a decrease in the proportion of full seed in the later catches, since the reduction in germination percent of full seed was merely from 85 to 70 percent during the same period.

Permanent milacre sample plots were established in the spring of 1952 in areas previously cut by the methods mentioned above, as well as in areas where only seed trees had been left and in one area where no cutting or recent burning had occurred. Despite the heavier initial catch of seedlings under shelterwood cuttings, the seed-tree plots had the most seedlings alive at the end of the very dry 1952 summer (table 15). On the uncut plots and the strip clear-cutting plots, all seedlings succumbed to the drought.

Table 15.--Pine seedlings per acre by cutting systems for various months in 1952 in east Texas

Cutting systems	Seedlings per acre, 1952			
	May	August	September	November
	- - - - - - - - - - - Number - - - - - - - - -			
Strip clear-cutting	17,312	4,562	62	0
Selection cutting	47,562	16,062	1,188	188
Seed-tree cutting	35,375	18,188	3,875	688
Shelterwood cutting	102,438	43,625	3,938	438
No cutting	3,562	500	125	0

The annual pine mortality among trees of sawlog size on areas cut either by selection, shelterwood, or seed-tree methods was 61 board feet per acre (Int. 1/4-inch log rule) for the first year after logging, and 81 board feet per acre for the second year. Insects and wind were the major immediate causes of loss, although fires which had occurred years before helped swell the total.

Slash pine spacing and thinning studies in central Louisiana

Slash pine planted in 1935 near Alexandria, Louisiana, at four different initial spacings was thinned in 1949, at age 14. Early development to time of thinning indicates that there is little to be gained from planting more densely than 1,150 trees per acre unless heavy early mortality is expected. Initial spacing had little noticeable effect on height growth. Table 16 shows average d.b.h. and yield of the differently spaced plantations.

Table 16.--Average d.b.h. and yield in rough cords per acre for 14-year-old stands of slash pine planted at various densities in central Louisiana

Number of trees initially planted per acre	Average d.b.h. at 14 years	Mean annual growth per acre	Total number of cords per acre at 14 years
	Inches	- - - Rough cords - -	
2,500	4.3	1.60	22.4
1,600	4.7	1.49	20.9
1,150	5.1	1.41	19.7
250	6.9	.69	9.7

In 1951 these plots were practically destroyed by ice and wildfire. Ice damaged 20 to 40 percent of the trees, but the damage did not seem to be correlated with either initial spacing or degree of thinning. The proportion of mortality due to wildfire in 1951 increased with lean, so that more than 80 percent of the trees leaning at least 15 degrees were lost.

Intermediate cutting of redcedar in north Arkansas

A study of methods of cutting in eastern redcedar stands in the Arkansas Ozarks indicates fair growth response to a combined improvement cutting of the cedar and removal of cull overstory hardwoods. This treatment did not result in quite as good growth as one where only cull overstory was removed. However, the former treatment obtained better quality growth and higher growth percent, and should eventually prove superior. Table 17 summarizes growth by treatments for the past five years.

Table 17. --Five-year growth of eastern redcedar in north Arkansas cut according to several prescriptions

Cutting treatment		Redcedar volume per acre			Periodic annual net growth rate (compound)
Merchantable redcedar cut	Overstory hardwoods cut	April 1948	Nov. 1952	Periodic annual net growth	
		Gross cu. ft., inside bark			Percent
None	None	507.9	549.6	8.3	1.6
None	All	681.3	807.7	25.3	3.5
All	None	46.8	100.6	10.8	16.6
All	All	39.3	79.8	8.1	15.2
Improvement cut	None	223.9	276.9	10.6	4.4
Improvement cut	All	326.9	428.4	20.3	6.8

The relatively good growth on the areas where all merchantable timber was cut is attributable to residual trees of marginal merchantability, and to ingrowth from released small saplings.

Old-field loblolly thinnings in north Louisiana

Thirty-six years of thinning research with loblolly pine near Urania, Louisiana, were summarized in an article entitled "Response of loblolly pine to thinning," published in the Journal of Forestry for June 1952 (pages 443-446). In brief, the article demonstrates that thinnings in stands younger than 35 years tend to decrease cordwood yield at age 35. However, where longer rotations aimed at production of both pulpwood and saw timber are adopted, and where there is a premium on early returns, light and frequent thinnings to salvage or anticipate mortality or forestall excessive shortening of the live crowns will increase yields. Heavier thinnings will shorten sawlog rotations by stimulating diameter growth, but will result in lower total cubic-foot yields.

Salvage cuttings in littleleaf areas of north Alabama

Near Birmingham, Alabama, improvement cuttings on areas heavily infected with littleleaf disease show that it may be wise not to leave even apparently healthy shortleaf pine trees unless another cutting is planned in less than 5 years. Observations in the fall of 1952 showed a 7 percent loss of apparently healthy shortleaf trees that had been left on an area cut in the spring of 1948. Mortality was greatest in trees over 9 inches d. b. h. The loss amounted to 11 percent of the cubic-foot volume in trees over 5 inches d. b. h. Twenty-six percent of the living shortleaf trees still alive in 1952 showed symptoms of the disease. Incidence increased with diameter--6 percent of 4- and 5-inch trees, 39 percent of 6-, 7-, 8-, and 9-inch trees, and 46 percent of the larger trees being afflicted.

TSI (non-commercial deadening) in north Alabama

Five years after shortleaf and loblolly pines near Birmingham, Alabama, were released (by cutting undesirable hardwoods according to three prescriptions), the pine cubic volume in trees larger than 4-1/2 inches was much greater than on plots where no hardwoods had been cut. In 5 years, cubic volume of pine increased 25 percent where no hardwoods were cut, 38 percent where all merchantable hardwoods had been removed, 60 percent where all hardwoods larger than 5-1/2 inches were cut, and 59 percent where all hardwoods larger than 1-1/2 inches were cut.

TSI in south Arkansas

Water emulsions of 2, 4, 5-T, and of 2, 4, 5-T with 2, 4-D, applied to southern red oak in frills in May proved very swift-acting and lethal near Crossett, Arkansas. Emulsions containing 1 gallon of commercial preparation (4 pounds acid equivalent) and 100 gallons of water were almost as effective as stronger concentrations. Five months after treatment they had killed at least 92 percent of the trees with less than 25 percent sprouting. Examination 18 months after treatment shows 100 percent of these test trees dead and practically no sprouting.

The same chemicals were sprayed on the butt 18 inches of uncut red oak trees in mixtures containing 1 gallon of commercial preparation (4 pounds of acid equivalent) and 20 gallons of fuel oil. Results were disappointing, although when the same spray was used on freshly cut stumps of trees 3 to 11 inches in d. b. h., less than 14 percent sprouted. The oil mixtures were less successful in preventing sprouting of stumps of 1- and 2-inch trees.

Ammate crystals in notches at ground level, half-ounce Ammate pellets in notches at ground level, water solutions of Ammate in frills (1, 2, and 5 pounds of Ammate per gallon), simple frilling, or double-hack girdling all resulted in high mortality (90-100 percent), with less than 23 percent sprouts on 3- to 10-inch southern red oak 18 months after treatment. These treatments were in May. November treatments were much less satisfactory; crystals gave poor kill and other methods allowed excessive sprouting. Ammate crystals in cups at 30 inches above ground gave very unsatisfactory results in both May and November.

In another phase of this test, trees frilled (but not poisoned) in May sprouted little, while trees frilled in November sprouted heavily. A study of seasonal effects has been installed.

The effectiveness of Ammate solutions (4 pounds of Ammate per gallon of water) applied by means of a Cornell tool was also tested. Jabbing 1-inch southern red oaks once and 2-inch oaks twice resulted in a 93 percent kill, with only 3 percent sprouting 30 months after treatment. The 4-pound solution appeared to be more economical than heavier or lighter dosages or concentrations.

TSI in the Mississippi Delta

Ammate solution in frills, 2, 4, 5-T in frills or as a basal spray, and ordinary girdling without chemical treatment are being investigated near Leland, Mississippi, as methods of getting rid of undesirable hardwoods. Costs of treatment, labor, and material have been analyzed, but it is still too early to compare effectiveness of the different methods. However, cost was found to be related to the sum of the diameters of the trees treated. Equations for estimating cost per acre for the various treatments are given below; the average number of trees treated per acre was about 13, with the sum of diameters equal to 167.

Girdling	Cost (dollars) = .0049 (sum D) + .28
Ammate (frill)	Cost (dollars) = .00570 (sum D) + .21
2, 4, 5-T (frill)	Cost (dollars) = .0038 (sum D) + .28
2, 4, 5-T (basal spray)	Cost (dollars) = .0073 (sum D) + .28

Labor was computed at 75 cents per hour, Ammate at 19 cents per pound, 2, 4, 5-T at 15 dollars per gallon, and Diesel oil at 14 cents per gallon. Ammate was applied in frills in a water solution (4 pounds per gallon of water), 2, 4, 5-T was applied to frills in mixture with water (4 pounds acid equivalent per 50 gallons of water), while as a basal spray it was mixed with No. 2 Diesel oil (4 pounds acid equivalent per 20 gallons of oil). Many commercial preparations of 2, 4, 5-T or 2, 4-D contain 4 pounds of acid equivalent per gallon, although some contain only 3. 33 pounds acid equivalent per gallon.

TSI in west Florida

A new soil sterilant, CMU, has shown early promise in west Florida of being a rapid and complete killer of undesirable vegetation. It is a powder, distributed broadcast on the soil. However, further work is needed on rates of application, residual effects, and costs. Meanwhile, Ammate crystals in notches and water solutions of 2, 4-D and 2, 4, 5-T in frills appear to be as effective in west Florida on turkey oak, bluejack oak, and dwarf post oak as they are elsewhere on other oak species.

TSI in east Texas

In east Texas, periodic annual height growth of variously released shortleaf pine seedlings surviving a five-year period subsequent to release has been .78 foot for overtopped trees given no release, 1.33 feet for trees released from overhead competition but suffering competition on 3 or 4 sides, 1.68 feet for similarly released trees with competition on less than 3 sides, and 2.12 feet for open-grown trees. Fifty percent of the originally overtopped, non-released trees died during the five years.

After three years of testing two methods of killing undesirable hardwoods with Ammate in east Texas, there appeared to be little to recommend the use of Ammate in notches at convenient chopping height. This method did not give adequate sprout control, though cheaper and slightly less hazardous than notches with Ammate at ground level--an effective treatment when sprout control is essential. Experience in other studies, however, indicates that a simple frill or girdle is cheaper and quite effective in killing tree crowns; when Ammate, 2,4-D, or 2,4,5-T in liquid mixture is applied to the frill, crown kill is hastened and sprouts are slightly reduced.

TSI in north Arkansas

Glaze damage to hardwood stands in the north Arkansas Ozarks makes cultural work imperative following cuttings. Inspection of permanent sample plots on the Sylamore Experimental Forest following the heavy ice storms of 1949 and 1951 showed that ice damage was less severe on ridges than on north-facing slopes. Basal area losses due to glaze were least in stands where all overstory had been removed and a small proportion of undesirable understory had been deadened, or where the overstory had been untouched but most of the undesirable portion of the understory had been deadened. Losses were greatest where the bulk of the undesirable understory had been eliminated as well as all the overstory, and where a dense understory and moderate overstory (including a number of culls) had been left untouched as check plots. The results of this analysis are shown in table 18.

Table 18.--Glaze damage to future crop trees in understory of hardwood stands in north Arkansas

Treatment	Glaze damage to understory			
	North slope		Ridge	
	Basal area per acre	Portion of total basal area per acre	Basal area per acre	Portion of total basal area per acre
	Sq. ft.	Percent	Sq. ft.	Percent
Complete liberation, heavy cleaning	15.8	60	6.7	28
Complete liberation, light cleaning	10.4	30	5.7	12
No liberation, heavy cleaning	1.8	28	4.4	19
Check	16.5	45	18.4	26

The chief reason for great damage in heavily cleaned, completely liberated plots was the large size of future crop-tree crowns. Liberation had tripled growth and the large increase in crown width and height gave more surface for ice accumulation than on lightly released trees. The damage to the crop-tree understory on the check plots is mainly attributable to ice causing large culls to fall and injure surrounding trees.

Undesirable hardwoods were deadened on 1,753 acres of the Sylamore Experimental Forest in north Arkansas to release potential crop trees and to secure pine reproduction in low-grade hardwood stands on south or west ridges and slopes where pine seed sources were available. Figure 6 shows such an area after treatment but before the crop of seedlings appeared.

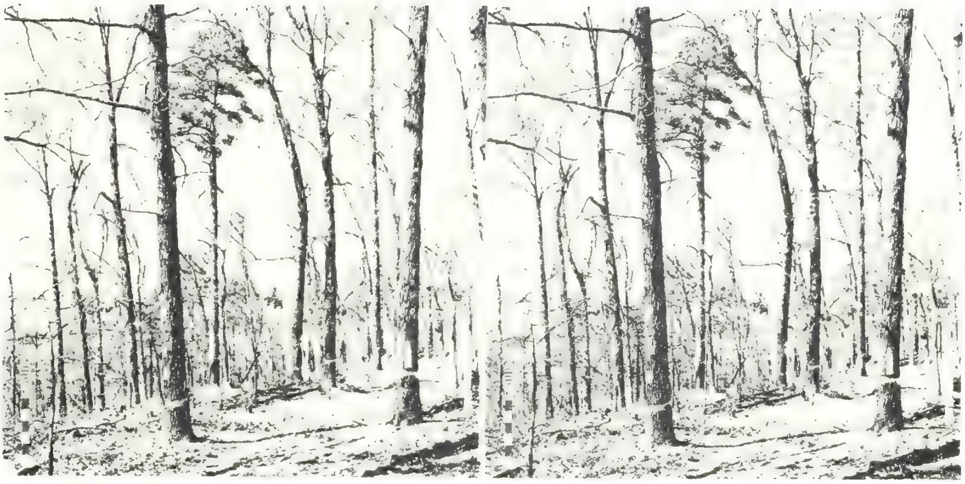


Figure 6.--In the Arkansas Ozarks, ridges and south or west slopes that are occupied by large undesirable hardwoods may sometimes be regenerated to pine by utilizing or deadening the larger hardwoods in the vicinity of pine seed trees. The stereo-pair above shows an area where deadening or removing all but 10 square feet of undesirable basal area per acre secured a catch of over 4,000 shortleaf pine seedlings per acre, with 80 percent of all milacres being stocked. The reader may see third-dimensionally without an instrument by looking slightly beyond the picture and causing the two images to merge optically.

Cost per acre of girdling overstory culls larger than 7.5 inches in d. b. h. and of applying Ammate crystals in cups at the base of smaller culls competing with growing stock averaged $3.37 for 3.4 man-hours of labor and $0.73 for Ammate crystals. Costs for other TSI were estimated from sample areas and are shown in Table 19.

Prior to TSI, a commercial improvement cut had been made on 2,630 acres of the Experimental Forest, removing 3,200,000 board feet (Scribner) of sawlogs and 600,000 board feet of tight cooperage material. Cost of tree-measuring all sawlog trees and classifying them as cut and leave at the time of marking was $0.75 per MBM. This eliminated later sawlog scaling costs, since sawlogs were sold on the basis of tree measurement.

Table 19.--Costs of labor and chemicals for removing various undesirable hardwoods in north Arkansas

Site and material removed	Labor[1]	Chemicals[2]
	- - - - Dollars	- - - - -
Hardwood sites		
Removal of overstory hardwood culls	2.44	0.45
Pine sites		
Removal of overstory hardwood culls and heavy weeding of smaller hardwoods	4.90	1.42
Complete removal of all hardwoods larger than 1/2 inch in d. b. h.	9.24	4.22

[1] Labor at $1.00 per man-hour (average for two laborers and one working foreman).

[2] Ammate at $0.135 per pound.

TSI in north Mississippi

In 1948 a scrub hardwood overstory on a dry ridge and upper slope near Oxford, Mississippi, was frilled and poisoned to release an 8-year-old loblolly plantation. Examination of the area in 1952 led to the conclusions:

> Release just before or just after underplanting pine is preferable, but release delayed as long as 8 years will stimulate loblolly pine growth.
>
> Single-hack frilling of blackjack, post, red, and black oaks and hickories killed them more effectively and cheaply than the Ammate-in-notch system of poisoning, although the Ammate reduced sprouting.

Whether trees are poisoned or frilled, sprouting decreases with an increase in tree diameter and is negligible above 12 inches.

Hardwood sprouts rarely overtake well-established pine reproduction on dry upland sites.

Delayed release probably causes underplanted pines to be more severely damaged by toppling dead trees than does release immediately after planting.

An article on the above study was published in the Southern Lumberman for December 15, 1952, and another has been submitted to the Journal of Forestry.

General principles for TSI in West Gulf pine-hardwood areas

Although new and more efficient techniques for killing undesirable hardwoods are constantly appearing, they tend to fall into four broad groups--chemical, mechanical, fire, and combinations. The following pictorial presentation suggests which group is best for six of the most common situations in Louisiana, southern Mississippi, southern Arkansas, and east Texas:

1. Large pine seedlings overtopped by low-grade hardwoods of various sizes.

2. Small pine seedlings dominated by undesirable hardwoods under 12 inches in diameter at breast height.

3. Pine seedlings and seed trees lacking; land occupied by inferior hardwoods under 12 inches in diameter.

4. Pine seedlings, of any size, under scattered, large, unmerchantable hardwoods.

5. Seed trees either present or absent; but small hardwoods, vines, and brush too thick for natural establishment of pine.

6. Longleaf pine land that lacks pine seed trees or seedlings and is occupied by small to medium-sized hardwoods.

⇑ A.--Pine seedlings 2 to 6 feet high, under an overstory of low-grade hardwoods of various sizes. TREATMENT: Girdle the hardwoods. The pines are large enough to keep ahead of any hardwood sprouts that develop.

⇓ B.--Small pine seedlings completely dominated by undesirable hardwoods under 12 inches in diameter at breast height and averaging 6 inches in diameter. These areas should get the highest priority, for the pines need immediate release. TREATMENT: Frill the hardwoods and pour in a solution of some sprout-inhibiting chemical like 2, 4, 5-T, 2, 4-D, or Ammate. Or put Ammate crystals in notches at the base of the hardwoods. Sprout control is of paramount importance, for the pines are too small to compete with the multitude of fast-growing sprouts that hardwoods under 12 inches in diameter send up when they are girdled but not poisoned.

⇑ C. --Area completely taken over by inferior hardwoods from 2 to 12 inches in diameter. Pine seed trees or seedlings absent or too few. TREATMENT: Plant pine seedlings or sow pine seed under the hardwoods. Before the pines are one year old, girdle all hardwoods over 12 inches in diameter and use sprout-inhibiting chemicals on the smaller ones. Where longleaf pine is planted, a second hardwood treatment may be necessary in a few years.

⇓ D. --Pine seedlings (any size) under scattered large unmerchantable hardwoods. TREATMENT: Girdle the hardwoods. Since sprouting from hardwoods above 12 inches in diameter is seldom serious, no poison is needed even if the pines are very small.

⇑ E.--Area so completely covered by small hardwoods (mostly an inch or less in diameter), vines, and shrubs that establishment of pine seedlings is next to impossible. TREATMENT: Clean up the site by using one of the several mechanical brush cutters now on the market, or possibly burn under rigidly controlled conditions. If enough pine seed trees are present, defer site preparation until just before a good seed year. If there are no seed trees, plant seedlings or sow seed.

⇓ F.--Former longleaf land now occupied by small to medium-sized blackjack oaks. Few or no pine seed trees. TREATMENT: Burn to set back the hardwoods and prepare the site, and then plant pine seedlings or sow pine seed. Before the pines are a year old, cut any hardwoods that are overtopping them. Especially if longleaf has been planted, poison the hardwood stumps to prevent sprouting.

Recovery of suppressed shortleaf and loblolly pines

Are suppressed loblolly and shortleaf pines capable of responding to release?

Studies at Crossett, Arkansas, suggest that suppression is not necessarily a symptom of permanent inability to grow rapidly, and that many suppressed pines can respond to release and develop into high-quality saw timber. In 1951 measurements were made on stumps whose narrow-ringed central core indicated that the trees had been suppressed in early life but had grown without serious competition after their competitors were removed. The average suppressed core had 39 annual rings and a diameter of 5.4 inches. Thus for almost the first forty years of their lives these trees had grown 1.4 inches in diameter every ten years.

The average increment after the start of accelerated growth was 4.2 inches every 10 years. From the time of growth acceleration to harvest (about 38 years), merchantable cubic volume increased from 2.7 to 78 cubic feet per tree. Board-foot growth in the same period averaged nearly 14 board feet (Int. 1/4-inch rule) per tree per year. Since the early years of suppression had left the major portion of the boles free of branches, the logs were very high quality.

Removing grass competition from longleaf pine seedlings in south Mississippi

Even a light stand of grass may seriously retard the growth of longleaf pine seedlings. In a study made by the Gulfcoast Branch near Saucier, Mississippi, all grass competition was removed from small square plots of various sizes by sifting the soil (through a 1/2-inch mesh screen) and replacing it on the plots. Longleaf seed was then sowed and the resulting seedlings later thinned to one per plot. Measurements of ground-line diameter made at the end of the first growing season showed that seedling size increased with plot size as follows:

Plot size (inches)	Check	6 x 6	12 x 12	18 x 18	24 x 24
Seedling diameter (inches)	0.22	.24	.25	.30	.32

The relation between seedling diameter and size of cleared area can also be expressed by the following equation:

Diameter (in inches) = 0.216 + 0.0044 x (side of plot in inches)

This test was on a loamy fine sand which supported a light stand of grass. Greater benefits might have been apparent had grass competition been more severe.

Trenching longleaf seedlings under a pole stand in south Mississippi

Root competition appears to be more important than overhead shade in the survival and growth of longleaf seedlings under a canopy of pole-size longleaf. This is shown by a comparison of seedlings from the 1947 and 1948 seed crops growing on trenched and non-trenched plots in south Mississippi. Trenching severed the lateral roots of the overstory pines, thus greatly reducing competition from that source. At the end of 1952, seedlings of both seed crops on trenched plots had better survival and nearly three times the mean root-collar diameter of seedlings on non-trenched plots (table 20). The trenched seedlings compared favorably in size and vigor with open-grown seedlings.

Table 20. --1952 survival and size of understory longleaf seedlings in south Mississippi

Seedling crop	Survival		Mean root-collar diameter	
	Trenched	Check	Trenched	Check
	- - - Percent - - -		- - - Inches - - -	
1947 seedlings	78	57	0.47	0.18
1948 seedlings	66	41	.44	.16

Trenching increased the growth of grass and weeds, and thus increased vegetative competition somewhat.

Survival of longleaf seedlings near seed trees in south Mississippi

On the McNeill and Harrison Experimental Forests, four-year survival of longleaf seedlings has been about as good near individual seed trees and large open-grown hardwoods as in the open. Only seven percent of the one-year-old seedlings from the 1947 seed crop within 30 feet of large trees died before four more growing seasons had passed; this compares with two percent mortality for open-grown seedlings in the same period. Seedlings from the succeeding year's crop behaved much the same; the respective mortalities were 11 percent and 13 percent after four growing seasons, though the initial observation was made when seedlings were only four months old.

Although early release of longleaf seedlings from overhead competition is deemed desirable, the above figures suggest that under the conditions of this test seedling mortality may not be severe even though release be delayed until five years after germination. Of course, it should be noted that the tests enjoyed nearly normal rainfall, freedom from severe brown-spot defoliation, and average or better sites.

Effects of seed trees and forest walls on longleaf seedlings in south Alabama

Findings of a study made near Brewton, Alabama, do not wholly corroborate the foregoing observations, but suggest that longleaf seed trees and forest walls do affect both the growth and the survival of longleaf seedlings. The average diameter of four-year-old seedlings within 7 feet of a seed tree was 0.50 inch, whereas seedlings 53 feet away had a diameter of 0.70 inch. The effect was even more pronounced on seedlings near forest walls (groups of trees). Here comparable diameters were 0.36 inch and 0.63 inch. A steady increase in root-collar diameter from seed tree or forest walls to the end of study transect (56 feet) indicates that the competitive effect extends at least 56 feet.

Since seed trees retard the growth of seedlings, it appears they should be removed as soon as an area is regenerated and seedlings are large enough to withstand ordinary fires.

The severity of border competition from forest walls argues against the use of small openings in group-selection regeneration of longleaf pine.

The seed-tree and forest-wall competition also increased mortality somewhat. Within 7 feet of seed trees and forest walls mortality over a four-year period was 31 percent, compared to 15 percent for seedlings 53 feet away. The discrepancy between these results and those cited above for south Mississippi is not excessive; it can possibly be attributed to the fact that Mississippi tests were on a better site or that grass conditions differed in Mississippi and Alabama.

Fertilizing longleaf seedlings with urea nitrogen in south Mississippi

Spraying longleaf seedlings with urea nitrogen (Nu Green) has failed to stimulate their growth. The reduction of brown-spot defoliation by spraying with Bordeaux mixture has had a much greater effect on growth.

Natural longleaf seedlings from the 1948 seed crop growing on a dry, sandy site in south Mississippi were sprayed four times in 1951 and five times in 1952 with urea nitrogen and Bordeaux mixture alone or in combination. Urea nitrogen was applied at a rate of 25 pounds of elemental nitrogen per acre per application.

At the end of two growing seasons, the untreated seedlings and those sprayed with urea nitrogen alone had both grown an average of 0. 06 inch in root-collar diameter. The seedlings sprayed with Bordeaux with or without urea nitrogen grew an average of 0. 12 inch in diameter. The effect of the Bordeaux spray was highly significant, statistically speaking, while that of urea nitrogen spray was not significant. Spraying with Bordeaux kept brown-spot defoliation down to 4 percent in December 1952, as compared with 54 percent for unsprayed seedlings.

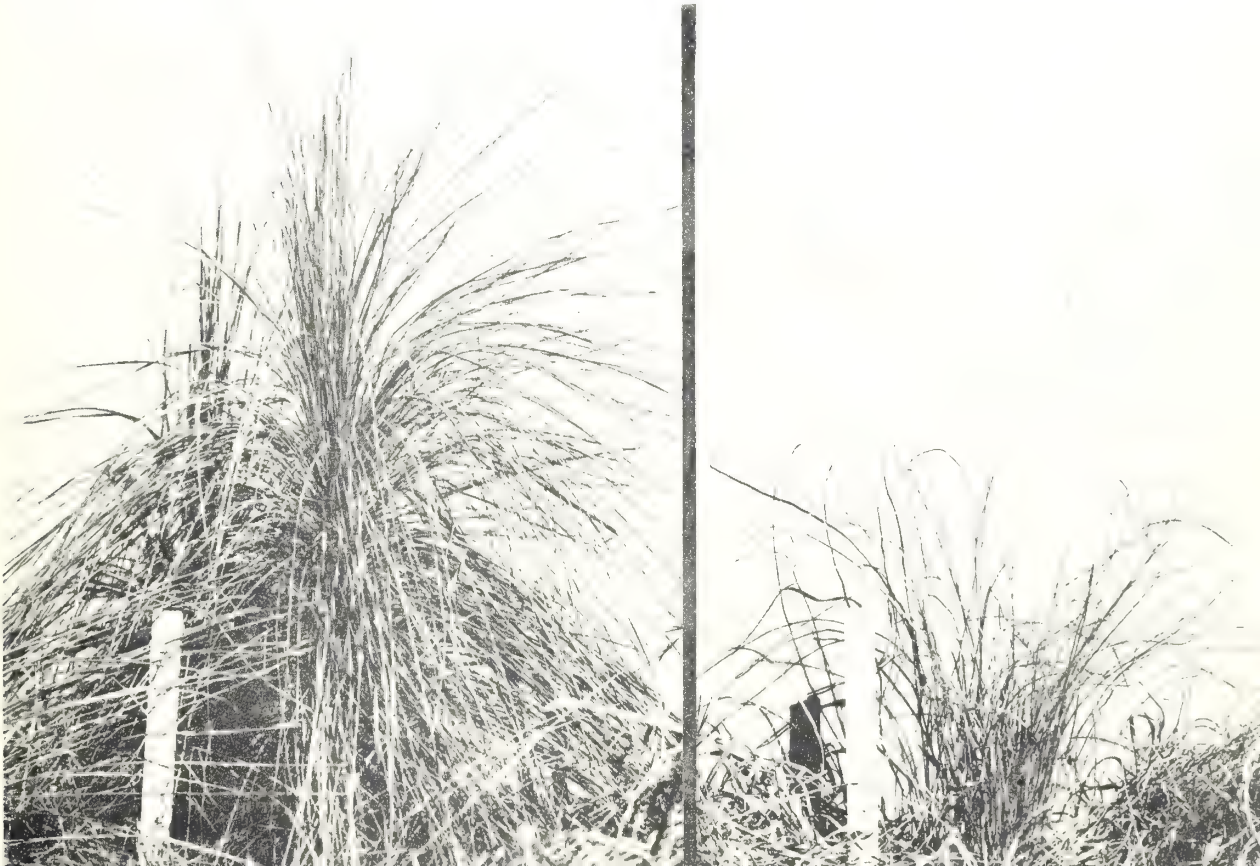
Root competition, brown-spot disease, and the growth of longleaf seedlings in south Mississippi

Where uniform, well-stocked stands of second-growth longleaf are wanted, it may be advisable to spend more money than is now customary on treatments that reduce grass competition and control brown spot. Shortening the grass-stage waiting period by such treatments may well compensate for the added expense.

In a study begun on the Harrison Experimental Forest in 1948, the grass on the entire study area was burned. Following this, logs were burned on half of the plots in order to kill grass and weed roots to a greater depth than is possible by ordinary burning. Longleaf seed were sowed in November 1948. On half the plots in each series, the resulting seedlings were sprayed with Bordeaux mixture to control brown spot. Ashes from half of those plots where logs were burned were spread on plots where grass burned. The presence or absence of wood ashes had no notable effect on seedling growth.

After four years, the ground-line diameter of seedlings where logs had been burned and Bordeaux spray applied averages 1.25 inches. The seedlings are starting to make height growth. Where no logs were burned and no brown-spot control applied, the fourth-year diameter averages 0.42 inch. This contrast is more notable in view of the fact that brown-spot defoliation has not been severe even on unsprayed seedlings. Log-burning or brown-spot spraying alone each increased average seedling diameter, though to nowhere near the extent of the combination treatment. Figure 7 shows the contrast of seedling development. Cheaper means of completely killing grass root stocks are being sought to allow use of the findings in commercial operations.

Figure 7.--Both of these longleaf pine seedlings are four years old. The one on the left grew on a site where the grass competition had been reduced before pine seed was sown· this seedling was also sprayed with Bordeaux to control brown spot. The seedling on the right received neither of these treatments.



A repetition of this study was established in December 1949. Over a three-year period the results have exhibited the same trends observed in the earlier study.

Vicksburg Infiltration Project

This project was assigned to this Station in 1951 and continued as a cooperative project with the Forest Service and the Corps of Engineers. The objective is the prediction of soil moisture content by correlation with other variables. Two reports have been issued on the soils of the Vicksburg, Mississippi, area, and a program has been planned for studies on soils of other regions. For reasons of national security, the progress reports are restricted from general circulation. However, the Forest Service will be able to publish certain parts of the data.

Specific emphasis during the past year was placed on the soil moisture regime of bare and vegetated areas at Vicksburg; soil moisture conditions under hardwood and pine covers; location and establishment of two study areas in other regions; analysis of soil moisture and climatic data secured from various experiment stations and subsequent formulation of prediction methods; the use of recently developed soil moisture and density measuring equipment that utilizes radioactive materials; field sampling and laboratory analysis of physical properties of soils representative of each experimental site; and preparing manuscripts dealing with instrumentation, methodology, calibration of soil moisture units, and various soil-water-cover relationships.

A total of 42 years of soil moisture records was obtained from four Forest Service Experiment Stations. Cooperative arrangements were made with the East Texas Branch of the Southern Forest Experiment Station and with the Division of Forestry, University of Missouri, to observe and record soil moisture and climatic conditions. Arrangements were also made to obtain approximately 16 years of moisture data from three stations of the U. S. Soil Conservation Service.

Mensuration

Techniques

A new technique for cruising timber without delineating plot boundaries or estimating tree d. b. h. was described in several Southern Station articles. The system employs an angle-gauge or optical fork which allows the observer to count all qualified trees without the necessity of leaving his sampling point. This simple and rapid count is proportional to basal area per acre, and if tallied trees are classified as to species, height, quality, or condition, the volume per acre for each class can be computed with relative ease. A few convenient constants needed in calculations, along with some specialized adaptations of the system, were published on pages 32-37 of the Journal of Forestry for January 1952. The same information was also issued in more popular fashion in Occasional Paper 126, "Shortcuts for Cruisers and Scalers."

This last publication also provides some easily memorized rules for estimating gross tree or log volumes, for cull deductions, for sample design, and for efficient machine accumulation of log lengths and diameters prior to conversion into various log rule volumes. Formulae for design of random samples and for sampling error calculations were also given.

In north Arkansas, a study on relative efficiency of different patterns of systematic sampling has been completed, along with observations on calculating optimum plot size and shape. In this locality, it was found that equispaced sampling patterns generally gave lower sampling errors than did random or non-equispaced patterns. Square plots seemed to be more efficient than rectangular plots, which is consistent with earlier findings. It was found that tenth-acre plots were more efficient there than larger plots for the stands tested, but it is possible that still smaller plots would have proved even more efficient.

Regulation of cut for even-aged Delta hardwoods

A schedule showing recommended residual bottomland hardwood growing stock after each of a series of intermediate cuttings in even-aged stands appeared in the Journal of Forestry for November 1952, on pages 866-867. After average d. b. h. of the stands exceeds 15 inches, a residual basal area of 100-118 square feet per acre in desirable growing stock is recommended, with the number of well-distributed, vigorous, good-quality trees per acre being gradually reduced from 78 (averaging 15 inches in d. b. h.) to 19 (averaging 33 inches in d. b. h.). Diameters other than 33 inches may be elected for terminating the rotation.

Growth of longleaf pine in south Mississippi

Four half-acre and five quarter-acre growth plots in south Mississippi longleaf pine have been under periodic observation since 1928 and 1923, respectively. The stand originated in about 1910. In 1947 basal areas per acre varied from 65 to 134 square feet. Net basal-area increase for the ensuing five-year period (1947-52) ranged from negative to 6.7 square feet per acre; mortality has been heavy on most plots. Net gain in cordwood for the five-year period has ranged from 2.4 rough cords per acre to 7.6 rough cords; this includes saw-timber and pole volumes, both of which are increasing rapidly because of ingrowth. Five-year diameter increase for trees larger than 6.5 inches has been poor, averaging from 0.56 inch to 0.93 inch. This reflects the retardation attributable probably to excessive crowding after the age of 20-25.

FOREST ECONOMICS

Forest Survey

Resurveys speeded by State and industry aid

Cooperative assistance supplied by the Alabama Division of Forestry, Louisiana Forestry Commission, Alabama Forest Products Association, and interested private companies made it possible, late in 1952, to greatly expand the inventory field work of the Forest Survey. Aid from these sources permitted increasing the number of two-man cruising teams from the 2 available under regular funds to 19 teams at the year's end, with still further assistance in prospect in Louisiana, Texas, and Oklahoma. The additional help will result in scheduled resurveys being completed one to three years ahead of earlier plans.

The first Forest Survey of Southern Station territory was made between 1932 and 1936, except for the Arkansas and Oklahoma Ozarks and Tennessee. Between 1946 and 1951, the Arkansas Ozarks and Tennessee were initially surveyed, Arkansas and Mississippi were resurveyed, and a resurvey of Alabama was begun. Field work in the northern half of Alabama was completed during 1952, and the remainder of the State is scheduled for completion early in 1953. A resurvey of Louisiana and of selected Texas and Oklahoma counties is also scheduled for 1953 (fig. 8).

Alabama Resurvey

The resurvey of Alabama's forest resources was begun in May 1951. Field work for the north half of the State was completed during 1952. Beginning in October 1952, cooperative assistance was provided by the Forestry Division of the Alabama Department of Conservation, Alabama Power Company, Coosa River Newsprint Company, Gulf States Paper Corporation, Hollingsworth and Whitney, Inc., International Paper Company, St. Regis Paper Company, and many other members of the Alabama Forest Products Association. The aid from these sources permitted increasing the number of two-man cruising teams in the field from 2 to 13. A training school for the additional cruisers was held at Auburn, Alabama, October 27 to November 7, using facilities of Alabama Polytechnic Institute. The field job in the southern half of the State was 40 percent done by year's end and is expected to be finished in March 1953.

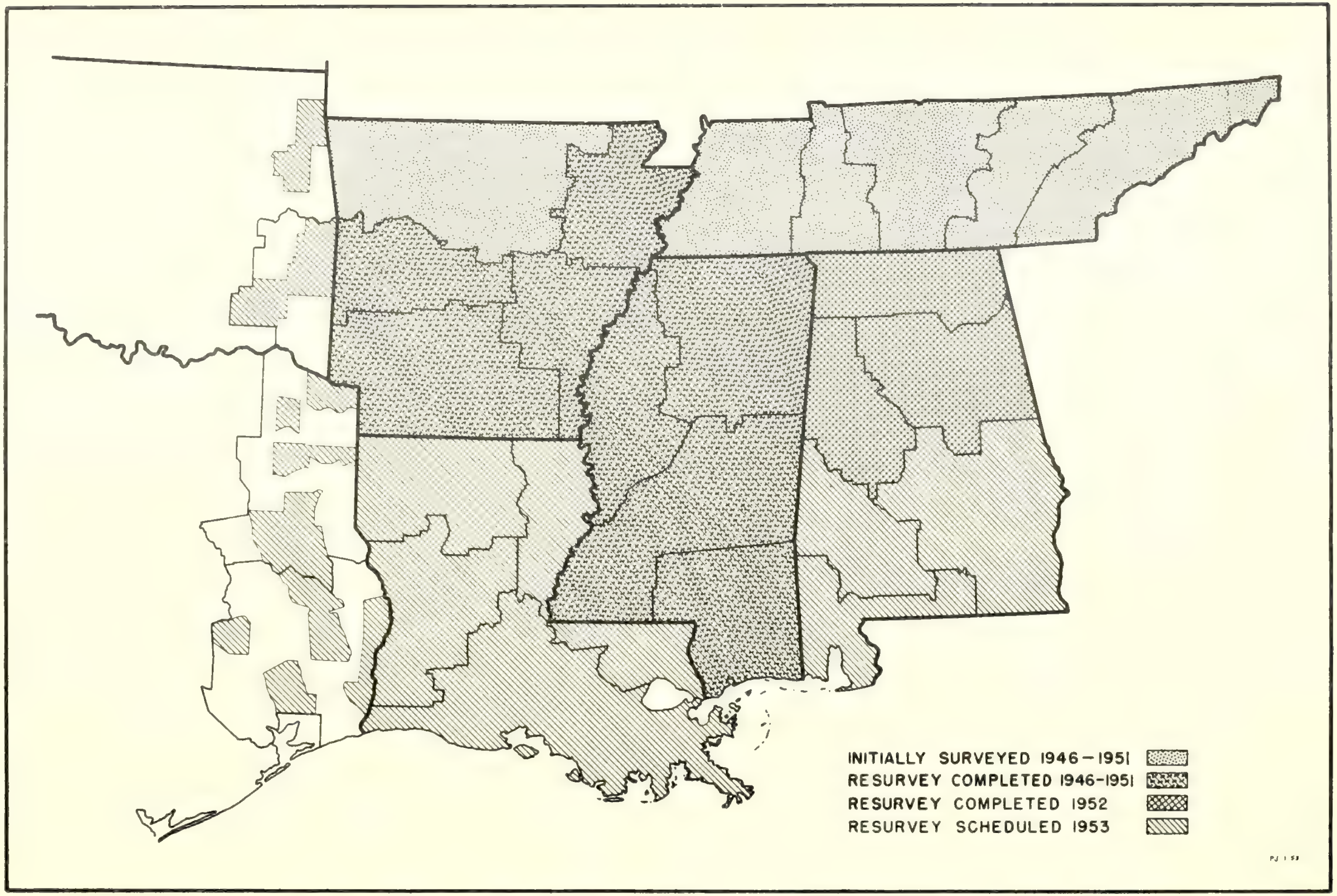


Figure 8.--Progress of the Southern Forest Survey since 1946. This survey is the second for most of the region shown, since all parts except Tennessee and the Arkansas and Oklahoma Ozarks were initially inventoried between 1932 and 1936.

The field work for an estimate of 1951 drain on Alabama forests was completed in 1952.

Arkansas forest resources and industries

Compilations were completed in 1952 on the survey of Arkansas' forest resources. This survey represents a reinventory of two-thirds of the State that was originally surveyed in 1934-36 and a first inventory of the Ozark Mountains. Assistance was given the State forester in the preparation of a popular brochure. A statistical report for the entire State will be published in the spring of 1953.

Arkansas has a land area of 33.7 million acres, of which 57 percent, or 19.4 million acres, is in forest. The proportion of forested land varies from about 70 percent in the Southwest and Ouachita Mountains to 58 percent in the Ozarks and 37 percent in the Delta.

Three-fifths of the forest acreage is in hardwood types. Bottomland species prevail in the Delta and along the rivers of the Southwest. The Ozark forests run heavily to upland oak, hickory, and gum. Loblolly and shortleaf pines predominate in the Southwest and Ouachita Regions.

One-third of the forest acreage is in saw-timber stands of 1,500 board feet or more per acre; almost a half is in pole-timber stands; and a sixth is in smaller stand sizes. The Southwest has 49 percent of its forest area in saw timber; the Delta, 43 percent; the Ouachita Mountains, 30 percent; and the Ozarks, 17 percent.

Sawlog volume totals 36.8 billion board feet (International 1/4-inch rule), of which 54 percent is hardwood. Oaks make up 54 percent of the hardwood volume; sweetgum and black and tupelo gums 19 percent; hickories 6 percent; and other species 21 percent. Shortleaf and loblolly pines account for 96 percent of the softwood volume, cypress and cedar for 4 percent. Total growing stock (merchantable trees 5.0 inches in d. b. h. and larger) is 9.8 million cubic feet--about 500 cubic feet per acre of forest land.

Current annual net growth in Arkansas is 549 million cubic feet for growing stock and 2,181 million board feet for saw timber alone. By comparison, cutting in 1948 for industrial and domestic use removed an estimated 411 million cubic feet of growing stock. The cut of saw timber was 2,055 million board feet. Although current growth appears to be in excess of commodity drain, timber volume in the resurveyed portions of Arkansas has declined since the initial survey.

In the 14 years between the two surveys, forest acreage increased 3 to 6 percent in the Ouachita Mountains and Southwest, but declined 19 percent in the Delta because of extensive land clearing. The acreage in upland hardwood and pine-hardwood types was increased at the expense of pine forest.

Generally speaking, volume in softwoods was reduced, volume in upland hardwoods was increased, and volume in bottomland hardwoods declined, the latter in rough proportion to forest acreage reduction due to land clearing. In a seven-county area east of the Ouachita River, however, where almost half the forest acreage is held by large lumber and pulp companies practicing conservative timber management, pine saw-timber volume increased one-third and total pine volume increased a sixth between the two surveys.

Throughout the resurveyed area, the proportion of small trees in the stands increased during the 14-year period.

In 1948, the forest drain from growing stock (all merchantable trees 5 inches in d. b. h. and larger) in Arkansas was an estimated 411 million cubic feet. Lumber accounted for 63 percent, fuel wood 13 percent, pulpwood 10 percent, veneer 3 percent, fence posts 3 percent, cooperage 2 percent, and other products 6 percent. Of the total cubic-foot drain, 57 percent was from softwoods.

Drain from sawlog growing stock totaled 2,055 million board feet. Of this, lumber made up 71 percent; fuel wood 12 percent; pulpwood 3 percent; other products 14 percent. Fifty percent of the sawlog drain was from softwoods.

Primary forest industries of Arkansas include some 1,700 sawmills; 2 pulpmills; 162 establishments manufacturing handles or handle stock, veneer, cooperage stock, hardwood dimension, and excelsior; a hardwood distillation plant; and 6 wood-preserving plants.

The 1,700 sawmills include 97 large mills, 68 of which are located in the Southwest region. Arkansas is a major producer of tight cooperage and handle stock, and an important producer of veneer and pulpwood.

Louisiana resurvey

The second Forest Survey of Louisiana was originally scheduled to begin in late 1954. Thanks, however, to cooperative assistance supplied by the Louisiana Forestry Commission, Gaylord Container Corporation, International Paper Company, and Frank Bennett and Associates, the reinventory got under way in December, 1952, with 6 two-man cruising teams in the field. From December 1 to 12 a training school for cruisers was held at the Alexander State Forest at Woodworth, Louisiana. Field work began the following week.

Other forest industry assistance for the Louisiana Survey is in prospect for the spring, when another training school for cooperator cruisers will be held. Completion of field work for the reinventory is expected late in 1953.

Tennessee forest resources and industries

A State-wide statistical report covering Forest Survey findings on forest acreage, timber volume, growth, and drain was published as Forest Survey Release 70. Work was started on a comprehensive report analyzing the State's forest resources and industries.

Almost half the land in Tennessee is growing timber-- forests cover 12.6 million acres of the State's total land area of 26.9 million acres. Saw timber totals 16.2 billion board feet and growing stock (sound, well-formed trees 5.0 inches d.b.h. or larger) is 4.9 billion cubic feet.

Current annual net growth in Tennessee is 244 million cubic feet (20 cubic feet per acre) on growing stock, 877 million board feet (71 board feet per acre) on saw timber. In contrast, 1949 drain was 209 million cubic feet on growing stock, 1,013 million board feet on saw timber.

Of the 209 million cubic feet of forest drain from growing stock in 1949, lumber made up 48 percent; fuel wood 34 percent; pulpwood 3 percent; other products 15 percent. Seventy percent of the total drain was from hardwoods.

Forest drain from sawlog growing stock totaled 1,013 million board feet. Lumber comprised 58 percent; fuel wood 28 percent; pulpwood 1 percent; other products 13 percent. Of drain on sawlog growing stock, 71 percent was from hardwoods.

Primary forest industries of Tennessee include some 2,700 sawmills, 4 pulpmills, and 191 non-lumber plants. The sawmills are chiefly of small size except for a group of larger mills in the Memphis area. The small mills cut 90 percent of the lumber manufactured in the State. The non-lumber plants produce large quantities of tight cooperage, handle stock, hickory dimension, and shuttleblocks.

1951 pulpwood production

In 1951, pulpwood production in the Station's territory was 6,318,740 cords, 13 percent more than in 1950 and 44 percent above 1949. Pine accounted for 87 percent of the 1951 production, or 5,526,201 cords; hardwoods for 13 percent or 792,539 cords.

For the entire South, production reached an all-time high of 14 million cords, 1.6 million more cords than the previous record year of 1950. The total U. S. cut in 1951 was about 25 million cords.

Among the southern States, Georgia was the leading producer with a harvest of 2,370,000 cords; Mississippi was second with 1,793,000 cords. All of the southern States showed an increase in the volume of pulpwood production over 1950.

Detailed information on the South's 1951 pulpwood cut was published in the Southeastern Forest Experiment Station's Forest Survey Release 38.

Timber Marketing

During 1952 the Mississippi Agricultural Experiment Station published Bulletin 494, "Timber Products Marketing in Northeast Mississippi." This is a report of the study of timber marketing problems of small woodland owners, made in cooperation with the Mississippi Agricultural Experiment Station in 1951. It completes this study.

The report shows that market outlets for timber in northeast Mississippi are numerous and widely distributed. Even small quantities of wood are generally marketable. However, the market for low-grade hardwoods is weak and the tie market is sporadic.

The factor that overshadows all other aspects of the marketing system is that timber owners are not realizing the potential production of their forest land. Their timber is of such quantity and quality that it is suitable for only a restricted range of products. The trend is toward further deterioration and depletion.

Suggestions for improving the situation are made. The most important one is that owners of small woodlands should be offered more assistance in improving their forest management.

Economics of Forest Management

Costs of logging

Records of year-round logging costs between 1947 and 1951 at the Crossett Experimental Forest in southern Arkansas show that large logs cost less to handle, per MBM, than small logs. In these 5 years, 47 different forty-acre tracts have been logged, and about 3,300 MBM of shortleaf and loblolly pine logs have been handled.

The crew, equipment, and manner of doing the work have been the same each year. All logs were cut by a two-man crew using a crosscut saw. Skidding was by an International TD-9, and loading on to trucks by a truck-mounted A-frame loader. Daily records of man-hours of labor for felling and bucking, and also for skidding, loading, and hauling, have been kept for logs of various sizes.

The man-hours per MBM (Doyle rule) for felling and bucking were 7.7 for logs averaging 40 board feet; 5.5 for logs of 60 feet; 3.7 for logs of 80 feet; and 3.3 for logs of 100 feet. The man-hours per MBM for skidding, loading, and hauling were 6.6 for logs averaging 40 board feet; 5.1 for logs of 60 feet; 3.5 for logs of 80 feet; and 3.3 for logs of 100 feet. An article on these results was published on pages 125-26 of Southern Lumberman for December 15, 1952.

Guides to profitable forest management

A study of financial maturity of shortleaf and loblolly pine in south Arkansas and north Louisiana was completed during the year. The report on the study defines and illustrates three vigor classes and tabulates gross and net tree values, production costs, and rate of tree-value increases when trees of different vigor classes are utilized for sawlogs. From these data simplified marking rules for use in the woods are set up. They show that where the trees are improving in grade or log length they are usually not financially mature unless either the growth rate is very low or they have reached at least 25 inches in diameter. Trees that show no prospective increase in grade or log length will achieve financial maturity at the diameters given in table 21.

The results of the study will be published as an Occasional Paper in the early part of 1953.

Table 21.--Marking guides for pines which are not expected to increase in log length or change in log grade

D. b. h. growth per decade	Desired rate of return	
	3 percent	4 percent
	- Tree d. b. h. (inches)	
3. 5 inches or more	25 - 29	21 - 25
2. 5 to 3. 4 inches	21 - 25	16 - 20
Less than 2. 5 inches	14 - 18	...

An ice storm early in 1951 damaged timber on the four forties of International Paper Company land in central Mississippi that have been set aside for a cooperative study of all-aged versus even-aged management. Infestations of the black turpentine beetle followed the ice damage and, together with 1951 and 1952 droughts, greatly increased timber losses. In 1952, Company foresters made a 100-percent inventory of the trees killed during the two-year period. They found that losses of the 1950 total cubic volume (trees 6 inches d. b. h. and larger) were 4. 5, 6. 2, 6. 3, and 7. 4 percent for the four forties. Losses of the total sawtimber volume (International 1/4-inch rule) were 1. 4, 2. 1, 2. 7, and 2. 8 percent for the four forties. Of the total number of trees below sawlog size (4 to 9 inches d. b. h.) on the four forties, about one-fourth were dead. The losses by diameter classes were: 4-inch, 19 percent; 5-inch, 26 percent; 6-inch, 35 percent; 7-inch, 26 percent; 8-inch, 21 percent; and 9-inch, 11 percent.

Although these losses are high, they are not serious enough to discourage timber management. It is reported that the last serious ice storm in this area occurred in 1914.

Returns from well-managed commercial forests

At the East Gulfcoast Research Center in southern Alabama, the fourth annual cut was made on a 641-acre tract of second-growth longleaf pine. The four cuts--part of a light improvement cut scheduled to cover about half of the tract in five years--have produced pine poles, sawlogs, and pulpwood worth $11, 500 delivered to market. On the stump these products were worth $3, 740. The cost of logging the products without a margin for profit and risk was $6, 270.

The cuts have been designed primarily to improve the quality and volume of the growing stock, which averaged only 2, 300 board feet

(International 1/4-inch rule) per acre when cutting began. The stumpage return, however, has been enough to pay all management costs of $850 for cruising, hardwood control, taxes, and the like. The forest has thus operated at a net profit of $2,890. Next year, at the end of 5 years of management, a second inventory will be taken and the gain in growing stock will be determined.

Returns from well-managed small tracts

Farm forestry studies were continued in 1952 at eight research centers. Field days were held in cooperation with the Extension Service or other agencies, and often several hundred visitors attended. On these occasions harvested products are usually piled at roadside; and money returns, cash costs, labor requirements, and forestry practices are explained during tours of the woods from which the products were taken.

Significant results from farm forestry studies at various research centers in several timber types are recorded below.

At the Alexandria Research Center, a long-time study is under way to determine economic returns from a 550-acre tract of cut-over land that will be managed for optimum timber and beef cattle production. The general objective is to get the cut-over land into high production of timber as rapidly as seems practical, and at the same time to get as much income as possible from a beef cattle operation.

Emphasis was placed this year on regeneration of open and understocked areas. Money for planting and scrub oak control was provided by a heavy salvage cut made in all compartments in 1951, after a severe ice storm. Two methods of regeneration--planting and direct seeding--were used to build up pine stocking on a total of 157 acres. Slash pine was hand-planted on 60 acres at a rate of 800 seedlings per acre. Cost per acre for labor, supervision, and planting stock averaged $8.97. About 16 acres were planted to longleaf pine--1,200 seedlings per acre--for an average cost of $13.58 per acre. The charge for planting stock for both species was $2.50 per M. The difference in planting costs was due mainly to the number of seedlings planted per acre, as rate of planting per man-hour was about the same for both species. Despite a dry summer, survival after the first growing season averaged 730 trees per acre for slash pine and 960 for longleaf, or 91 percent and 80 percent survival, respectively.

Eighty-one acres were direct-seeded to longleaf pine by sowing 3.5 pounds of seed per acre in early December 1951. The area was burned before seeding. The crew, which was equipped with "cyclone" seeders, seeded nearly 3 acres per man-hour. The direct costs averaged $4.02 per acre, counting $3.33 per acre for seed, $0.39 per acre for labor and supervision in sowing, and $0.30 per acre for controlled burning. The following stand was found on the seeded areas after the first growing season:

Over 5,000 seedlings per acre on 12 acres
Over 1,700 " " " " 56 acres
Over 800 " " " " 13 acres.

The cost of direct-seeding longleaf pine per established acre (750 or more seedlings per acre) was less than one-third as high as the cost of planting seedlings. However, longleaf direct seeding has not always been as successful as this.

Some of the area planted to pine in 1951-1952 was dominated by cull hardwoods. Therefore, release by girdling the hardwoods was started in May 1952 and completed by midsummer. About 50 acres in the slash pine planting and 45 acres in longleaf were treated. The girdling job on all 95 acres required 295 man-hours of labor or just over 3 hours per acre. The average cost was $2.80 per acre.

The pasture was grazed yearlong by an experimental herd of 23 cows and heifers. A temporary electric fence was installed to prevent grazing on the planted and seeded areas during winter and spring. The cooperator, Mr. J. C. Johnston, purchased a purebred Hereford bull during the year, and is otherwise endeavoring to improve his herd. Economic data on the cattle operation are not yet compiled.

At the *Birmingham Research Center*, annual harvests have been made for 5 years on one moderately stocked and one poorly stocked tract of 35 acres each. The timber type is second-growth shortleaf-loblolly pine and upland hardwoods.

The total volume harvested during the 5 years on the moderately stocked tract was 10,155 board feet (International 1/4-inch rule) of pine and hardwood sawlogs and 6,793 cubic feet of mine props. These products had a stumpage value of $222, a roadside value of $1,042, and a delivered market value of $1,551. The harvest from the poorly stocked area was 6,065 board feet of logs and 2,020 cubic feet of mine props, worth $62 on the stump, $348 at roadside, and $514 at the market.

The cut each year on each tract was well below the growth. The 1952 harvest from the moderately stocked tract was 83 board feet of pine and hardwood logs and 52 cubic feet of mine props per acre. The value per acre of these products was $1.84 on the stump, $7.55 at the roadside, and $11.61 delivered to market. The 1952 cut per acre from the poorly stocked tract was 87 board feet of logs and 8 cubic feet of mine props, all from low-grade hardwoods. The per-acre value of these products was $0.57 on the stump, $2.02 at the roadside, and $3.11 at the market. About 10.4 man-hours of labor per acre was required to cut and deliver the products from the moderately stocked tract and 4.1 man-hours per acre on the poorly stocked tract.

At the Central Ozarks Research Center, improvement cuttings and cultural work were completed on five small management units on the Koen Experimental Forest. The purpose of this study is to determine the relative productivity and net returns of managed forests on different sites in the Arkansas Ozarks. Shortleaf pine, hardwood, and eastern redcedar sites are represented. A summary of volume removed in the initial improvement cutting and stumpage prices received on each management unit is shown in table 22.

Table 22.--Volume cut and stumpage income per acre by management units

Management unit and site	Total area	Volume cut per acre					Total stumpage receipts per acre
		White oak staves	Hardwood sawlogs	Pine saw-logs	Redcedar		
					Saw-logs	Posts	
	Acres	- Bd. ft. (Scribner)	- -			No.	Dollars
Hardwood:							
Cherty north slope	39	172	1,923	...	...	...	25
Sandy north slope	48	124	951	51	7	3	15
Shortleaf pine:							
Cherty south slope	18	245	1,368	177	...	...	27
Sandy south slope	28	18	413	2,844	50	3	43
Eastern redcedar:							
Limestone ridge	20	28	287	30	155	95	12

Man-hour labor requirements to fell, buck, skid, and load the various forest products were as follows:

White oak stave bolts--38 man-hours per MBM (Scribner rule)
Hardwood sawlogs--17 man-hours per MBM (Scribner rule)
Pine sawlogs--15 man-hours per MBM (Scribner rule)
Redcedar sawlogs and posts--15 man-hours per one hundred cubic feet.

Following the improvement cutting, cull hardwoods were deadened in order to release desirable growing stock. The procedure was to girdle culls over eight inches in d. b. h. and to poison (with Ammate crystals in a girdle) only gum, elm, and chinquapin, which are difficult to kill or which sprout profusely. Unwanted trees below eight inches were treated by applying Ammate crystals in cups near the groundline. Man-hours per acre for labor and supervision varied from 2. 2 to 7. 5. Total costs per acre ranged from $2. 26 to $8. 41 on the 5 management units.

At the Crossett Research Center, the intensively managed "good" farm forestry forty of loblolly and shortleaf pine continues to show the considerable income possibilities of timber farming in south Arkansas and north Louisiana. The fifteenth annual cut (fig. 9) was made from this 40-acre area during the year. It produced 16, 710 board feet (Doyle scale) of pine logs and 11. 05 cords of pine pulpwood.

These products were worth $737 in the standing tree, $931 at roadside, and $1, 126 delivered to the mill. This is equivalent to a stumpage return of $18. 42, a roadside value of $23. 28, and a market value of $28. 14 per acre for the year.

Because a large proportion of the products were logs, the hourly returns for the labor needed to cut and deliver the products were unusually high this year. The gross return per hour was $5. 39 (for both equipment and labor). The return after subtracting all out-of-pocket costs was $4. 77, and the gross return for labor and use of equipment after deducting the return for stumpage was $1. 86 per hour.

During the 15 years that this tract has been under management, it has yielded 191, 242 board feet (Doyle scale) of logs, 323 cords of pulpwood, 228 cords of chemical wood and firewood, and 418 pine fence posts. These products have had a stumpage value of $4, 179, a roadside value of $7, 372, and a market value of $10, 565.

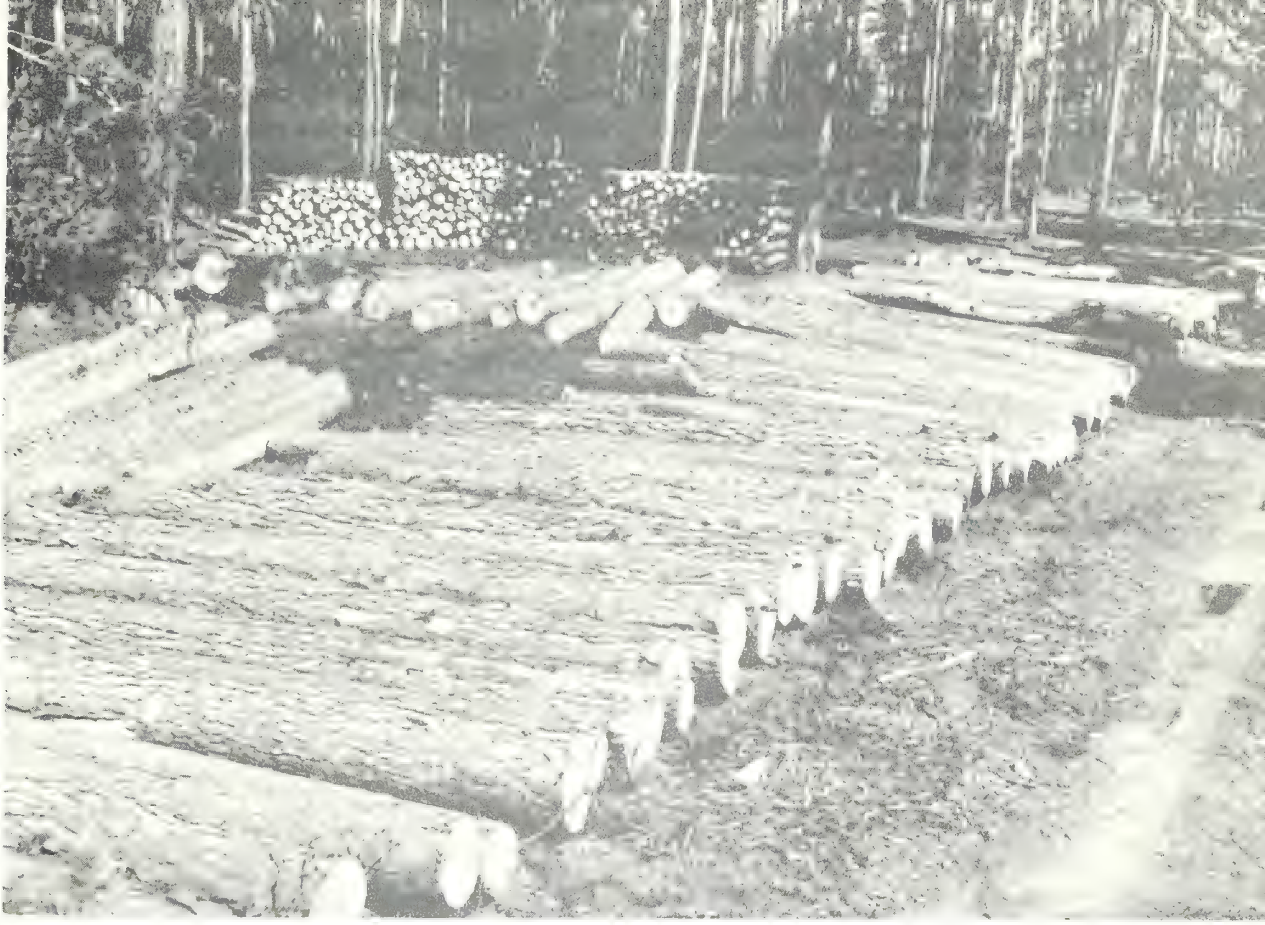


Figure 9.--The 1952 cut from the "good" farm forestry forty at Crossett. During the past 15 years, this tract has yielded an average annual harvest of more than 300 board feet of sawlogs and half a cord of pulpwood per acre.

All of this indicates that the well-stocked and well-managed farm forest can be one of the most profitable parts of the farm in much of the hill land of the South.

Again this past year approximately half of the yearly growth was removed in the fourteenth annual cut made on the 34-acre "poor" farm forestry forty. The other half of the growth was allowed to remain in order to build up the growing stock. The logs and pulpwood cut in 1952 had a stumpage value of $360, a roadside value of $475, and a market value of $590. It is apparent that the poor forty is rapidly catching up with the good forty from the standpoint of growth and income.

The East Gulfcoast Research Center has completed the first five annual harvests on a reasonably well stocked longleaf pine forty near Brewton, Alabama. In these five years, 21 MBM of pine logs, 38 cords of pine pulpwood, 21 barrels of crude gum, 24 cords of hardwood firewood, 380 fence posts, and 38 pine poles have been harvested.

These products were worth $2,094 delivered at the market, or $750 on the stump. Cash outlays for equipment, supplies, tractor operation, and hauling to market were $554, leaving $1,540 for labor and stumpage. The return for labor alone, with stumpage deducted, is $790, or $0.53 per man-hour. Annual costs for taxes, marking paint, tree poison, and the like have averaged about $5.00. Per acre, the annual return for stumpage has been $3.75, or $3.62 with the annual management costs subtracted.

There is more and better timber in the area now than when cutting began. In 1947, when the first cut was made, the volume per acre was 3,050 board feet (International 1/4-inch rule), less than one-third of that possible under good management. Many of the trees were also of low quality. The five annual cuts have been taken mostly from less desirable trees, and the volume of the cuts has been limited to two-thirds of the annual growth, leaving the rest of the growth to build up the forest.

Commercial logging operations were not possible on a poor longleaf forty also near Brewton. The few scattered longleaf pines there must remain as seed trees. A small turpentine operation, such as a farmer might handle in his spare time, was installed on these seed trees and some fuel wood and hardwood fence posts were cut. The market value for all products during four years of management was $575. Earnings above all out-of-pocket harvesting expense have averaged about $123 annually. This has been enough to pay taxes on the land, purchase four or five thousand trees for planting each year, and leave a net balance of about $100 in cash or its equivalent in fuel wood and fence posts.

At the East Texas Research Center, a 67-acre farm forest of second-growth shortleaf and loblolly pines mixed with hardwoods is divided into 5 thirteen-acre compartments. One compartment is cut each year. This method provides both an annual harvest and a 5-year cutting cycle under the single-tree selection system.

The 1952 harvest, which completes the first cutting cycle, removed 5,500 board feet (gross Doyle rule) of pine, 1,300 feet of white oak, and 1,800 feet of red and post oak and sweetgum, or a total sawlog volume of 8,600 board feet. For the compartment cut this year this is 620 feet per acre or approximately 18 percent of the original average volume of 3,500 board feet. The value of the sawlog material harvested in 1952 was $232 as stumpage and $461 as delivered sawlogs. The per-acre return when averaged for the entire 67-acre area was $3.47 as stumpage and $6.88 as delivered logs.

Since 1947 the following products have been harvested from the farm forest: 24,000 board feet (Doyle rule) of pine and 18,200 board feet of hardwood logs, 883 hardwood ties, 3.6 cords of pine pulpwood, and 124 hardwood fence posts. These products had a total value of $1,144 as stumpage, or $2,586 as material delivered at the mill. Corresponding per acre per year values are $2.85 for stumpage and $6.42 for delivered products.

After each cut, timber stand improvement work is carried out in the compartment harvested. This operation deadens any low-grade hardwood if it is overtopping an established pine. In January of 1952 such work was done on the 13 acres harvested in November 1951. Ammate was used only on small trees completely severed or on those difficult to girdle because of scars or other obstructions to the axe. A total of 273 trees with a total basal area of 123 square feet was treated. Diameters of trees deadened ranged from 4 to 20 inches; the average was 9.1 inches. Total costs were $14.27 for labor and $0.17 for Ammate, or an average charge of $1.12 per acre.

On the four compartments given intensive stand improvement work since 1949, the average number of stems treated per acre was 32 and the average diameter at breast height was 8.9 inches. The average cost per acre was $1.31.

Both saw timber and seedlings on the farm forestry unit have suffered from the extended droughts of 1951 and 1952. The 1951 drought, with some slight assistance from bark beetles, killed nearly 8 times as much pine saw timber per acre on the two remaining uncut and unimproved compartments as it did on the three that had received improvement cuts and intensive TSI work in 1948, 1949, and 1950. Saw-timber mortality averaged 8 board feet per acre on the three treated compartments and 63 board feet per acre on the uncut areas. At $30.00 per MBM (Doyle rule) for stumpage, these losses are $0.24 and $1.89 per acre respectively. Stands were generally understocked, but most of the mortality occurred in dense clumps of pines. Harvest cuttings on the treated areas had thinned such groups and thus may have been as important as the timber stand improvement work in conserving soil moisture during dry weather. On the untreated areas the $1.89 loss per acre is considerably in excess of the $1.31 spent per average acre for hardwood removal.

The summer and fall drought of 1952 killed very few pines of sawlog or pulpwood size. The most serious damage was the virtual elimination of the seedling crop which germinated in the spring of 1952. In June 1952, a systematic survey of the farm forestry area using milacre plots showed that seventy-nine percent of these plots each contained one or more (up to 68) pine seedlings. By November 25 the percent of plots stocked had fallen to 19, and the number of seedlings per plot ranged from 6 downward--usually only 1 or 2 per plot.

At the Gulfcoast Research Center, the first 5-year reinventory of longleaf and slash pine on the four farm forties on the Harrison Experimental Forest showed that annual volume growth per acre ranges from .43 cord for the lightest to .76 cord for the heaviest stocking. The annual volume growth per acre of sawlog timber has been 149 to 235 board feet (International 1/4-inch rule). The board-foot growth rates are low chiefly because of poor stocking--2,200 board feet for the lightest and 3,500 for the heaviest stocking at the beginning of the 5-year cutting cycle. They are low also because a considerable portion of the sawlog volume on all of the forties is in old-growth longleaf, which grows slowly.

At the Tallahatchie Research Center, three forties of badly depleted second-growth shortleaf pine and upland hardwoods are being rebuilt to good stocking under different intensities of management. Little timber has been sold to date, but approximately 100,000 board feet of low-grade hardwoods on the three tracts combined has been marked for removal next spring in a commercial tie and timber sale.

On 10 acres of Tract I (medium intensity of management) and on 25 acres of Tract II (high intensity of management) desirable crop trees have been selected and marked, areas lacking desirable stocking have been interplanted to obtain full stocking, and all crop trees and planted seedlings have been released from both high and low competition of undesirable hardwoods. Approximately 11 man-hours per acre of an owner's time would have been required for planting and about an equal amount of time for hardwood control. Planting of both pine and hardwood seedlings has been very successful.

RANGE RESEARCH

Grazing Management

During the past decade, southern forest grazing problems have been intensified by the following developments: 1.--Increased number of livestock in the South; 2.--increased range fencing as a result of new fence laws in Alabama, Florida, and a proposed law in Louisiana; 3.--clearing of forest land for pastures; 4.--widespread acceptance of prescribed burning in the longleaf-slash pine types, a development generally favorable to grazing; and 5.--a more positive approach to grazing on the southern national forests.

Low productivity of range livestock continues to be a major difficulty. Beef herds on forest range still average only about 50 percent calf crops, 300-pound calves, and as high as 5 percent death losses. This record can be greatly improved through better management.

The Escambia Experimental Forest in south Alabama was one of the first areas in 1952 to move toward fenced management of forest range in response to the new Alabama stock law, which took effect June 1. A local cattlemen's association was organized and 2,728 acres of the Experimental Forest were fenced. Sixty-nine head of the association's cattle were admitted to the forest under rules designed to provide for good grazing practices properly coordinated with timber management. Association members keep herd management and cost records which will be used to determine beef production and cash returns from forest grazing.

With the assistance of the Southeastern Forest Experiment Station, a field training session in forage inventory of the wiregrass type was held for rangers of the Florida National Forests. This training on the measurement of the kind and amount of range forage was intended to help the national forest organization arrive at a realistic evaluation of conservative grazing capacity and improved management.

Seasonal grazing on forest range

A new study at the Alexandria Branch in central Louisiana aims to find a practical system of grazing management and animal nutrition that will increase beef production. Three experimental ranges of 580 acres each were established in 1951 on cut-over pine lands now dominated by slender bluestem.

In 1952, one range was grazed heavily (1/2 acre per cow-month). The object was to determine whether intensive grazing will stimulate current growth of young tender shoots enough to provide forage of higher quality during summer and thus lengthen the gaining season for the cattle. This range will be rested in 1953, while a second range is closely grazed. A third range is stocked every year at a conservative rate of 1 acre per cow-month. The 125 beef cattle used in the experiment are typical native stock owned by 5 nearby farmers. To test the source of winter nutrition on beef production, about 50 cows are grazed on the range for 9 months in spring, summer, and fall, and are fed or pastured on the farms during winter. The remaining 75 head graze the range yearlong.

Supplemental feeding was started in November and December 1951 and continued for an average of 112 days. The average daily ration was 1 64 pounds of protein concentrate, plus some hay. The average cost of this ration was $9.09 per head for the 3-1/2-month season. For the first year, calf crops from the five herds averaged 52 percent; death losses were 3.4 percent for cows and 6.4 percent for calves, all about average for cattle on forest range in this part of the South.

Seasonal gains of steers on the McNeill Experimental Forest in south Mississippi were somewhat lower in 1952 than in 1951. In 1952, the 48 yearling steers gained a total of 4,129 pounds on forest range. The previous year the same number of steers gained 4,397 pounds. The smaller gains apparently were caused by the prolonged summer drought which prevailed through much of the South. Grass production in open unburned forest at McNeill was only 690 pounds per acre, the lowest since the very dry growing season of 1948.

In two short-season ranges at McNeill, a total of 32 steers were grazed from March 17 to July 7, and in two long-season ranges 16 head were grazed from March 17 to September 29. The short-season steers gained 81 pounds per head, the long-season ones 96 pounds. Because of the heavier rate of stocking, however, the 32 steers in the short-season ranges gained a total of 2,599 pounds, compared with 1,530 pounds for the 16 head in the long-season ranges.

In late winter of 1952, parts of these four ranges were prescribe-burned to control brown spot on longleaf seedlings. In early July 1952, forage utilization averaged about 11 percent on the unburned areas and about 84 percent on the burned areas in the four pastures.

Grazing and prescribed burning on slender bluestem range

A study was started in central Louisiana to determine whether some combination of grazing and prescribed burning may cause better native grasses to replace slender bluestem on forest range. The study area has 18 fenced paddocks of 1/3-acre each. Six paddocks are heavily grazed, six moderately grazed, and six ungrazed. The burning treatments--each on 6 paddocks also--are wildfire, prescribed burn, and unburned. One half of each paddock was planted with longleaf and slash pine, 5 rows of each.

The study paddocks were grazed by cattle between April 28 and June 23. The moderately-grazed paddocks received 10 cow-days of grazing each; the heavily-grazed paddocks, 20 cow-days.

Herbage production on the paddocks in 1952 averaged 2, 148 pounds of grass and 147 pounds of forbs per acre, air-dry weights. Grass utilization on heavily-grazed paddocks averaged 69 percent. Moderately grazed paddocks were utilized about 58 percent. The cattle did not damage the planted pine seedlings even in the heavily-grazed paddocks.

Firebreak strips around the study area have been burned during late winter for the last two years. In 1952, ungrazed grass production on these twice-burned strips was only 1, 250 pounds per acre. This was 900 pounds or 42 percent less than on the plots that were burned in 1951 only. Thus the possible loss of forage production through excessive use of fire may be considerable.

Herbage production on Arkansas Ozark woodland ranges

In sparse stands of poor hardwoods in the Arkansas Ozarks, annual observations of ground cover have been made for six years after wildfires occurred. In this period, the cover of dead litter increased from 8 to 31 percent; bare soil decreased from 24 to 4 percent; bare rock decreased from 25 to 21 percent. Green herbage cover remained about the same, but forage production declined because unpalatable brush increased and palatable grasses decreased.

Ground cover of open grassland unburned for 6 years remained nearly constant, with an average cover of 51 percent green vegetation, 30 percent dead litter, and 19 percent bare soil (table 23).

Table 23.--Changes in ground cover after burning in Ozark upland hardwoods

Ground cover	Woodland range; years since burn--			Open grassland unburned for 6 years
	1-2	3-4	5-6	
	Percent			
Green herbage	43	38	44	51
Dead litter	8	25	31	30
Bare soil	24	12	4	19
Bare rock	25	25	21	0
	100	100	100	100

Total herbage production, as measured in August of each year, was most strongly influenced by variation in the amount of rainfall that occurred 30 days prior to measurement. Production was lowest on all study areas during years that were deficient in rainfall during late July and August; it was greatest in years with normal to excess rainfall in July and August.

Lowest grass production on these woodland ranges was 23 pounds per acre during a dry year on a heavily grazed and frequently burned area. At the other extreme, 411 pounds per acre of grass was produced in a lightly grazed, unburned woodland in a wet year. However, average grass production on woodland ranges for the six years was only 100 pounds per acre. This grass production for the rather poor hardwood areas studied indicates a conservative grazing capacity of about 20 acres or more per cow for an eight months' season.

In contrast, grass production on unburned open meadow averaged 836 pounds per acre, and ranged from 465 pounds in a dry year to 1,102 pounds in a wet year. Conservative grazing capacity here is estimated to be 8 to 10 acres per cow for an 8 months' grazing season.

Grazing damage to planted pines

Woods hogs seem to adapt their pine-eating habits to changed conditions. If one kind of pine seedling is not available, others may be damaged. Though woods hogs prefer longleaf pine root bark, they will take slash pine roots if no longleaf is available. Ordinarily they do not seriously harm loblolly pine, but a loblolly pine plantation in central Louisiana was seriously damaged by hogs in the spring of 1952.

The loblolly seedlings had been planted on 478 acres at a 6- x 8-foot spacing during the winter of 1949-50. In the spring of 1952, about 83 percent or 757 pine trees per acre were living and averaged 4 feet tall. Then hogs moved into the plantation and rooted trees from March to July. An average of 472 loblolly pines per acre were killed and 90 more were damaged. Only 195 trees per acre were left undamaged. The hogs girdled or stripped the bark from around the main stem and upper root near ground level. The damage was not noticed until the pine needles started turning brown, 4 to 5 weeks after the trees were girdled. The loss in trees and growth has been estimated at $25.00 per acre. As a consequence, the land-owning company cancelled its order for some 3 million trees for planting in 1953.

A hog-damage survey of a mixed planting of loblolly and slash pines in the same general area revealed that the hogs had girdled and killed 52 percent of the slash pine but less than 4 percent of the loblolly trees.

In a controlled study of hog damage in central Louisiana, a total of 3,025 longleaf pine seedlings and 2,422 slash pine seedlings was available to 4 woods hogs from March to July 1952. The hogs--which were fenced into the 12-acre study area--started rooting the longleaf about May 5 and stopped about June 5, when the ground became dry and hard. In one month, they destroyed 80 percent of the longleaf pines, but less than one percent of the slash pines. The pines had been planted in 1950-51 and 1951-52, so the slash pine did not have the large lateral roots that hogs seem to prefer.

Good-Rite ZIP, creosote, Rosin Amine-D Acetate, and Forestasan were tested on longleaf pine seedlings as hog repellents. None of these chemicals kept hogs away from pine seedlings. An electric fence with two charged wires 10 and 19 inches above ground was also ineffective. The hogs jumped this fence and destroyed all longleaf pine seedlings back of it.

Deer browse production and utilization

The effect of heavy deer grazing on browse production has been a cause of considerable concern on the Sylamore District of the Ozark National Forest in recent years. In 1945, 36 permanent plots were established in three browse types (all closely grazed by deer) to measure forage production trends on plots protected from deer as well as under continued deer grazing. The number of deer on the area was gradually reduced through hunting and trapping. By 1951, average browse production had doubled on both grazed and ungrazed plots, and there was no evidence of excessive deer browsing on any of the plots in that year. On some plots that had been very heavily browsed previously, the vegetation responded very slowly to protection, so that the actual quantity present was still low.

Within fenced exclosures production of herbage (green-weight basis) in the hardwood-grape-greenbrier type increased from 321 pounds per acre in 1947 to 1,036 pounds in 1951. Open check plots increased from 256 to 507 pounds per acre. In the eastern redcedar-greenbrier type, herbage production increased from 740 to 924 pounds per acre within fenced exclosures, and from 357 to 748 pounds per acre in the open check plots.

In the pine-huckleberry browse type, however, the trend of herbage production was generally downward. Production decreased from 1,039 to 544 pounds per acre in the exclosures, and from 803 to 658 in the grazed plots. Since there was no evidence of heavy browsing by deer or cattle in this type, the decreased browse production was attributed to the fact that the overstory timber stand was so dense that it killed off many browse plants.

Control of Undesirable Hardwoods

Studies in central Louisiana show that blackjack oaks can be satisfactorily controlled with 2,4,5-T or 2,4-D. These hormone-type chemicals are most effective when applied in spring and least effective when applied in the fall.

The best combination of top and root kill was obtained with a 2-percent 2,4,5-T ester in oil applied in frills. This gave effective top kill from all seasons of application, but sprouting was prolific on trees treated in fall and winter. Sprouting was not serious on spring-treated trees. A 1-percent 2,4,5-T ester in oil, and 2-percent 2,4-D ester in oil (both chemicals being applied in frills) gave effective crown kill and not much sprouting for the spring application.

For stump treatments, a 2-percent 2,4,5-T ester or a 2-percent 2,4-D ester in oil was effective if applied in spring. A 3-percent 2,4,5-T ester in oil was best for applying to stumps at other seasons.

For basal sprays applied to the lower 16 inches of tree trunks, a 2-percent solution of 2,4,5-T ester in oil was effective when applied in spring. Results of winter spraying were not always good, and summer and fall applications were generally unsatisfactory A 3-percent 2,4,5-T ester in oil solution was little better than the 2-percent. A 2-percent solution applied as a trunk spray in spring gave satisfactory kill, but winter treatments did not give consistently good results Summer and fall trunk sprays were unsatisfactory

CMU will kill blackjack oaks when applied in spring to the soil or to individual trees. Tree tops were killed by 5.6-percent CMU in water applied in frills on blackjack oaks, but all trees later produced vigorous basal sprouts. Stumps sprouted profusely after a 5.6-percent solution of CMU was applied as a sprout inhibitor However, spraying the lower 16 inches of the tree trunks with this same concentration killed 98 percent of the trees, and only 10 percent produced basal sprouts. Broadcasting dry CMU at 43 pounds per acre (an extremely heavy dosage) effected an 86-percent crown kill without basal sprouts. Spraying hardwood sprouts with a 5.6-percent CMU solution in water killed 90 percent of the sprouts without resprouting. All of these treatments are so expensive that CMU cannot be recommended for hardwood control unless prices are reduced considerably or tests with much lower concentrations prove effective.

Results of a study in central Louisiana show that scrub hardwood control can greatly increase forage production on forest ranges planted to pine.

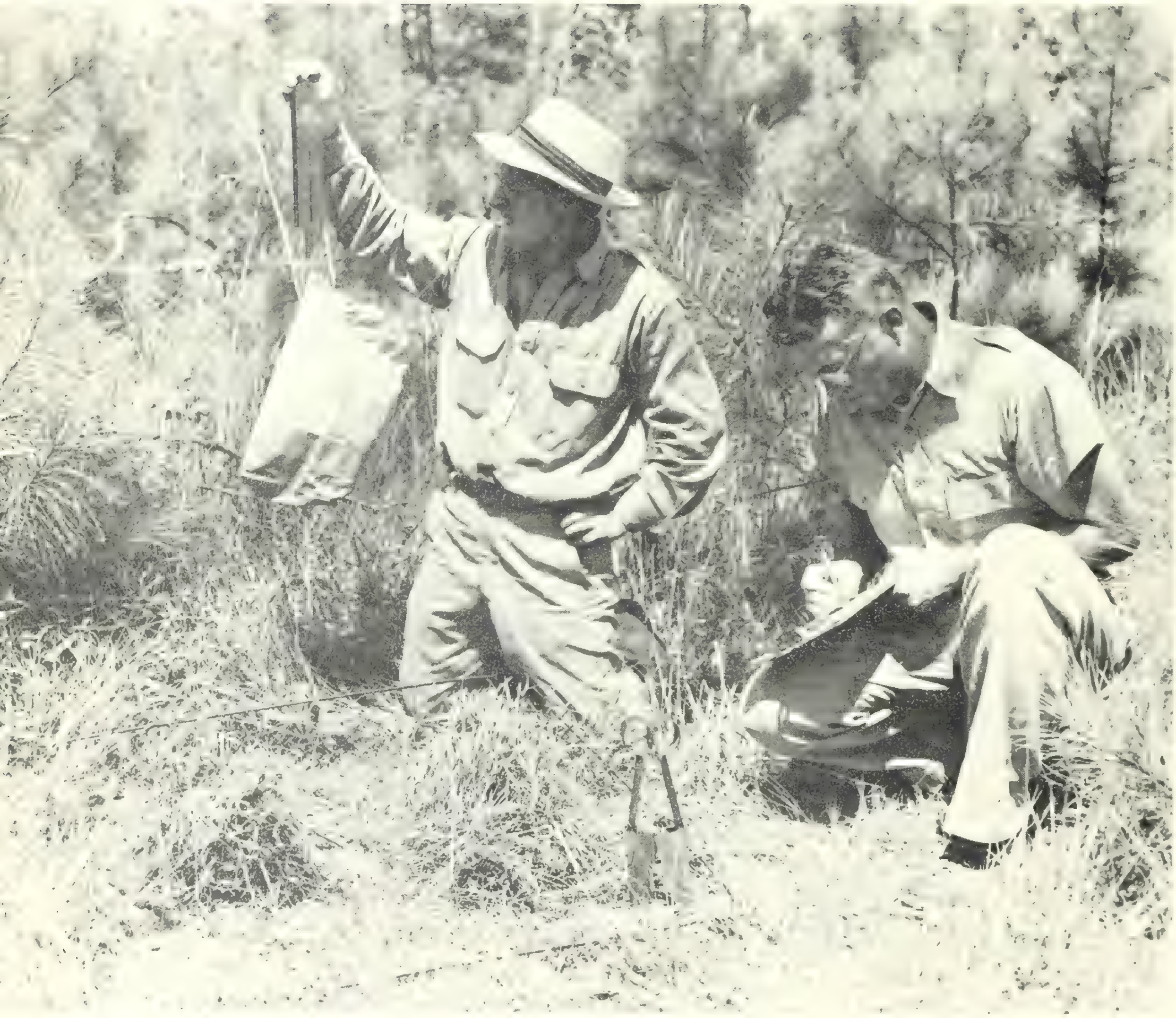


Figure 10. --Grass production in this young slash pine plantation more than doubled within three years after the scrub oak overstory was deadened.

A test area was planted to longleaf, slash, and loblolly pines, and the worthless scrub oaks were poisoned. Before treatment, the grass was very thin under the hardwood thickets. But the first season after treatment the grass clumps grew much taller and began to spread. Cattle were attracted to the rapidly growing forage. The yield of grass more than doubled within three seasons after the scrub hardwoods were controlled, and the high forage production should persist for 10 to 15 years before the planted pines close over (fig. 10).

Under well-managed grazing, the increase in forage can repay the cost of hardwood control (up to $5.00 per acre) before the pines reach merchantable size. An article on this study was published on pages 462-63 of the Journal of Forestry for June 1952.

Artificial Revegetation

The seeded and fertilized firebreak blocks established in the spring of 1950 at the Alexandria Branch in central Louisiana were stocked with dairy cattle again in 1952. The grazing season began April 8 and ended October 24. This 2.5-acre area provided 364 cow-days of grazing, or 4.8 cow-months per acre. The same amount of grazing was obtained in 1951, and slightly less in 1950.

The summer and fall of 1952 were unusually dry, with only one good rain in mid-July. Carpetgrass and lespedeza dried up or stopped growing during the dry weather. Under these conditions during 1952, common lespedeza seeded alone made a better firebreak than where it was seeded with carpetgrass. Grazing on the firebreak plots during the past 3 years has been close at times, but at the end of each season enough dry herbage was left on most of the area to allow a fire to creep slowly across under favorable burning conditions.

Several forage plants were seeded in open longleaf pine stands on the McNeill Experimental Forest in south Mississippi during the period 1947-50 in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering. Nearly all have been crowded out by native grasses and by accumulated pine litter. An exception is sericea lespedeza sowed in March 1950 on prepared seedbeds and given various rates and types of commercial fertilizers. With no grazing this species has made vigorous growth for 3 years on fertilized plots. It may prove valuable in improving summer grazing on forest range.

Big trefoil on cultivated and fertilized plots in an open pine stand thinned out badly at the end of three years, after promising early growth. Application of superphosphate in April 1952 did not help this species. These plots will be burned in the winter of 1952-53 to remove the rough and test the effect on the trefoil stand.

FOREST UTILIZATION SERVICE

The Forest Utilization Service continued to operate as a liaison between the U. S. Forest Products Laboratory, other forest-products and utilization research groups, and the timber growers and wood-using industries of the South.

Wood Waste Utilization

The utilization of heavy sawmill waste for pulp chips is developing rapidly, and Occasional Paper 115, "Amount of chippable waste at southern pine sawmills," continues in popularity. Two of the large pine mills that cooperated in the studies and tests for this paper have installed barkers and chippers and have contracted chips to pulp mills. The Forest Utilization Service has also helped several other sawmills to determine the volume of usable waste that they are producing.

It seems very likely that the utilization of heavy pine sawmill waste for pulp chips will soon be widespread in the South, for both sawmill firms and pulp and paper companies are showing an active interest in the huge volume of wood that this waste comprises (fig. 11).

Figure 11.--Total volume of waste from sawing fifty-four 11-inch pine logs. Waste from logs of this diameter runs about 0. 5 cord per MBM, green lumber tally. In general, waste varies with the size of the logs being sawed--from about 0. 3 cord per MBM in large logs to . 75 cord in small logs.

The expansion of the pulp and paper industry and the present and potential demand for raw material are the general reasons for this encouraging development, but the movement has been given impetus by the improvement of log barkers. Patent difficulties have been resolved and mechanical changes made on the Andersson barker, and the cutterhead type of barker is also showing considerable promise.

Wood Molasses Feeding Tests

The Texas Agricultural Experiment Station has completed the cooperative cattle-feeding tests in which molasses from southern hardwood trees was compared to blackstrap and other types of molasses. Final reports are being prepared on the nutritional values of the molasses for both beef and dairy cattle.

The wood molasses used in the test had been stored for about 15 months before it was fed. During this time it settled out badly, developing a deposit that made it unusable in mechanical mixers and disagreeable in appearance--and hence lacking in sales appeal. The U. S. Forest Products Laboratory has undertaken research to improve the quality of the molasses.

Wood Quality and Pulp Yields

A recent report on "Variability in anatomical features and their effects on properties of second-growth yellow pine," by M. Y. Pillow of the U. S. Forest Products Laboratory, indicates that heretofore-unknown factors affect pulp yield. One of these factors appears to be the fibril angle.

The work to date has been on loblolly pine in the South and slash pine in the Southeast, but it is planned to extend the research also to longleaf and shortleaf pine. The Forest Utilization Service is cooperating with the Laboratory in these investigations and plans to correlate the work with similar research in the schools of forestry at two southern universities.

Hardwood Log Grades

The U. S. Forest Service has adopted, as standard for its own use, the hardwood factory-lumber log grades prepared by the Forest Products Laboratory and the hardwood tie-and-timber log grades formulated by the Forest Utilization Service for the Forest Service Committee on Interim Hardwood Log Grades for the South. (These tie-and-timber log grades were originally published in the booklet, "Interim sawlog grades for southern hardwoods".) Use of the Forest Service's standard grades for hardwood logs is gradually being accepted by industry, particularly where close evaluation of log quality is necessary. Two training schools in the use of the grades were given during the year.

Mesquite Charcoal

In the South and Southwest a vast acreage of mesquite is being destroyed for range improvement. In an attempt to develop uses and markets for the unwanted mesquite (and thus reduce the cost of eradicating it from range lands), the Forest Utilization Service cooperated with the Texas Forest Service and the Southwestern Forest and Range Experiment Station in making a test run of mesquite charcoal.

One cord of mesquite from Texas and one cord from Arizona were burned in a Connecticut-type kiln in east Texas (fig. 12). The Forest Utilization Service furnished the cooperators with a detailed operational report on the kiln run and the U. S. Forest Products Laboratory analyzed the charcoal.

Results indicated that the yield and quality of charcoal from mesquite is probably equal to that of commercial oak charcoal. As an outcome of this test, a private concern has constructed a battery of Connecticut kilns in the Southwest. Mesquite and other woods in that area are being used.

Assistance to the Armed Services

At the request of the Air Force, the Forest Utilization Service cooperated with Region 8 of the Forest Service in reviewing the utilization and management practices of the Eglin Air Force Base in northwest Florida.

This large air proving ground (formerly the Choctawhatchie National Forest) has some 500,000 acres of forest land. Air Force officials are attempting to manage, cut, and utilize the timber as soundly and as economically as possible. They are operating a modern permanent circular sawmill, planer mill, and dry kiln in order to furnish lumber and timbers for Eglin Field and other nearby air bases. A joint report suggesting improved woods and utilization practices was prepared and submitted to the commander of the base.

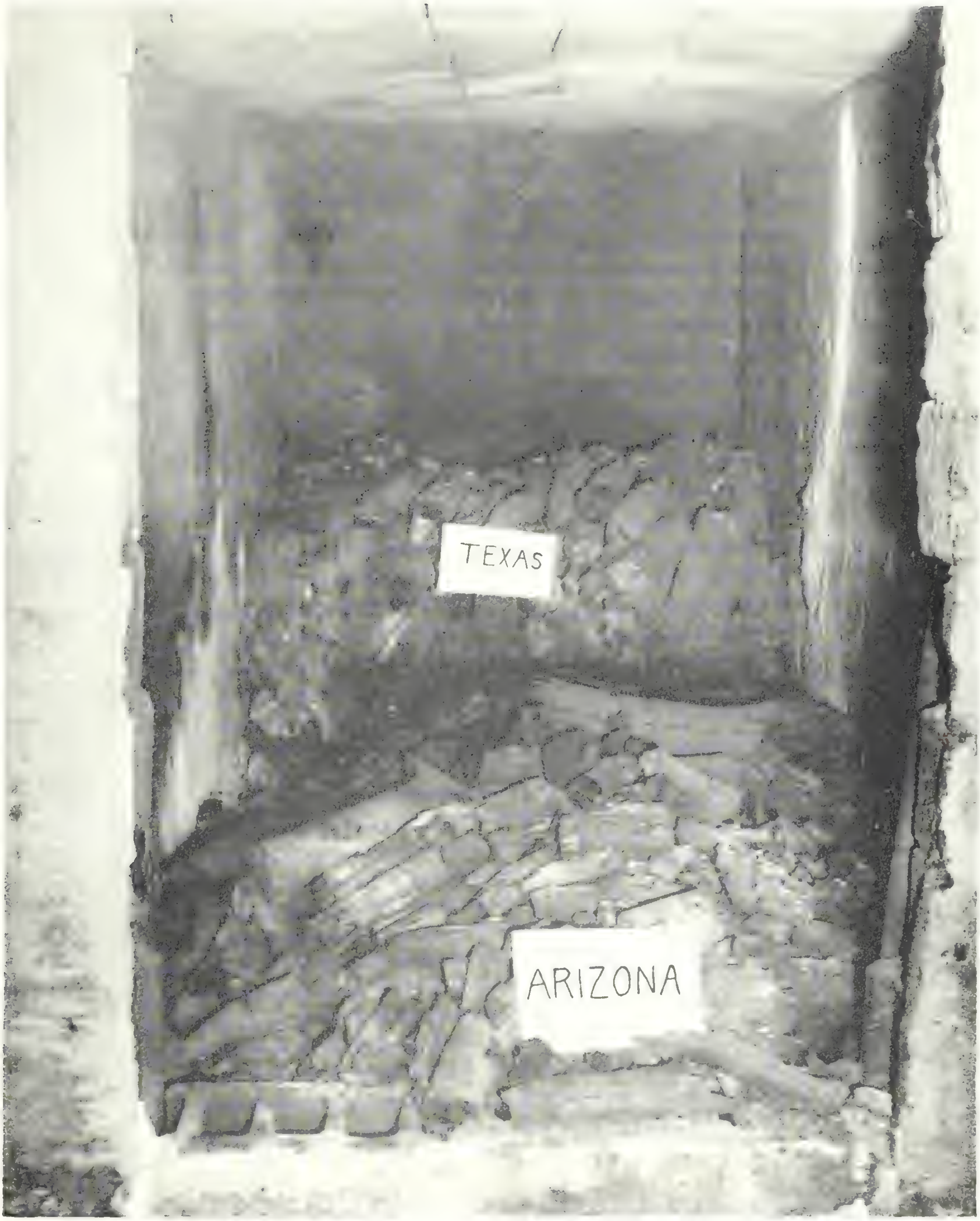


Figure 12.--Interior of Connecticut-type charcoal kiln after a run on mesquite from two different sources. Analysis indicates that mesquite charcoal is equal to other charcoal now on the market.

The Forest Utilization Service has been working closely with Higgins Industries, Inc., of New Orleans, who are constructing nonmagnetic, laminated wooden minesweepers for the Navy. The firm has contracts for ten of the 165-foot sweepers. Five hulls are well along. Initial difficulties in delamination resulting from improper wood seasoning and faulty gluing procedure were corrected early, and results of subsequent delamination tests by the Forest Products Laboratory have been exceptionally good.

The white oak and Douglas-fir lumber being used in the minesweepers is being kiln-dried by Lumber Enterprises, New Orleans. The Forest Utilization Service has worked very closely with this firm and has been of considerable help in improving the drying procedure.

Cooperative Projects with U. S. Forest Products Laboratory

Sample material was shipped to the Forest Products Laboratory for several cooperative research projects in improved wood use:

> For revising Technical Bulletin 479, "Strength and related properties of woods grown in the United States," to include second-growth material: 30 log sections of second-growth loblolly pine from southern Arkansas and 23 sections of second-growth shortleaf pine from central Alabama.
>
> For studies in the cutting and drying of veneers, and for developing improved kiln schedules for lumber, particularly for water tupelo: A total of 18 veneer logs of swamp blackgum, sweetgum, and water tupelo from southern Louisiana.
>
> For experiments in improving and developing processes for making pulp and paper from wood grown on the farm: Two cords of sweetgum from southern Arkansas.
>
> For studies of the preservative treatment of wood by methods suitable for farm use: 60 fence posts of post oak and water oak from east Texas.
>
> For research into improved gluing techniques and for revising Technical Bulletin 1500, "The gluing of wood," to include the synthetic resin glues: Sample material from seven species of bottomland hardwoods in Mississippi.

For experiments in the gluing and lamination of wood that has been treated with preservative: Three MBM of southern pine from Alabama.

Advice and Guidance to Industry

As in the past years, there has been a strong demand from the various wood-using and wood-producing industries for advice and assistance in the solution of difficulties. The Forest Utilization Service accordingly spent a considerable amount of its time in working with private firms in matters ranging from wood identification to seasoning, preservation, painting, utilization of waste, and the adaptation of wood to new uses.

Painting problems--which include peeling, mildewing, and premature failure--have increased in recent years. The chief causes of trouble are the increased use of fast-grown wood, low-quality paint, and improper construction and painting practices. Unfavorable weather has also been a factor.

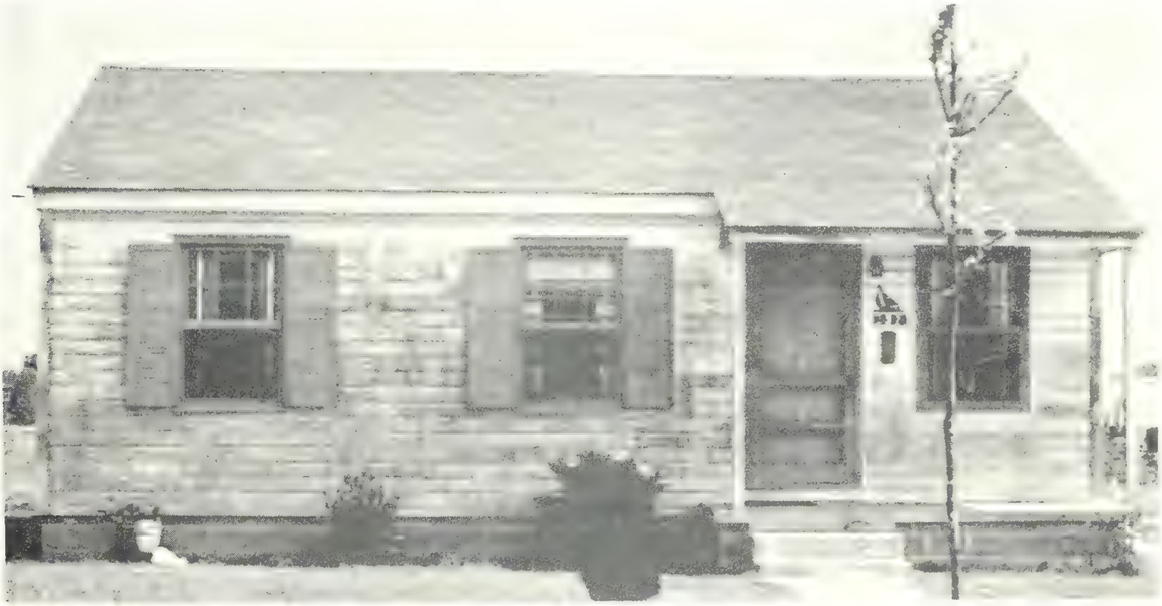


Figure 13.--Serious mildew on white paint, 12 months after painting.

FLOOD CONTROL SURVEYS

Good progress was made in advancing the Station's flood survey program despite a heavy cut in funds and subsequent retrenchment in survey activities. These watershed surveys develop and evaluate upstream programs for flood prevention which complement major engineering works for flood control, downstream. In recent years the surveys have, more and more, become identified with Interagency planning efforts to formulate integrated resource-development plans for major drainage basins.

A main accomplishment during the year was completion of the Ouachita and Lower White River surveys, and preparation of tentative draft reports presenting estimates of flood control needs, program recommendations, and costs and benefits. This information was made available to task forces of the Federal-State Interagency Committee, which is developing a comprehensive plan of improvement for the Arkansas-White-Red River Basin. The Basin plan is to be completed by 1954 and, among other things, will require integration of flood survey recommendations with other agency proposals for the White and Ouachita River drainages.

Station personnel, in carrying forward the flood survey job, also participated actively in many related phases of the AWR Basin planning effort. This included service on numerous teams and work groups that are developing estimates of conservation needs for forest, range, and openlands; harmonizing basic agricultural data; evaluating conservation benefits; and coordinating agency proposals for flood control, drainage, and other water use and control functions.

Although watershed survey proposals for flood prevention chiefly entail land treatment measures, they sometimes include structural works as well. An example is the system of small floodwater detentions as studied for the Cane Creek watershed in southern Missouri. The design is for earth-fill dams, each with automatic drawdown tube and sodded spillway storing about 8-1/2 inches of runoff and emptying in 10 days. The 16 planned structures would receive the flow from watersheds of 1 to 24 square miles, and in aggregate would utilize 2,363 acres in reservoirs for temporary storage of runoff. The system would have a benefit-cost ratio of 1.23 and would reduce average annual flood damage in downstream reaches of Cane Creek an estimated 30 percent. An important aspect of the Interagency Basin study is that of determining the relative merits of such proposals and whether these belong in an integrated water-use and control plan.

Although the survey of the Hatchie River and adjacent drainages (Tennessee and Mississippi) had to be curtailed because of lack of funds, considerable basic field work was completed. This included surveys to measure valley cross-sections and to map floodplain use, channel erosion, and land damage. In all, cross-sections were obtained for some 80 stream reaches, and land use and damages were mapped on 210 reach samples.

In July the Station initiated a flood survey of the Cumberland River Basin (Tennessee and Kentucky). This is one phase of a 3-year cooperative study by State and Federal agencies to develop a comprehensive agricultural program for the Basin. Limited funds held progress during the year to organization activities, development of work plans, and enlistment of agency cooperation.

The Station also assisted the Soil Conservation Service on forestry phases of flood surveys assigned to that agency. Forestry recommendations for flood prevention and supporting data were supplied for the Red River Basin. Completed also was a field survey of the forest lands of the Sabine-Neches River Basin (Texas and Louisiana) and a report on their hydrologic condition. Analysis of data from a similar survey of the Coosa River area above Rome, Georgia, showed 6 percent of the forest land in good hydrologic condition--the highest proportion found to date in the various watersheds surveyed throughout the South. Forest Service contributions to the Coosa review survey were completed on schedule and presented as draft report material supplying forestry program recommendations, cost-benefit analyses, and other data.

EXPERIMENTAL FOREST DEVELOPMENT

Alexandria

Materials and supplies for a 3-room dwelling on the Palustris Experimental Forest have been purchased. The building will be erected in 1953. A fire lookout tower and dwelling have been constructed on the west side of the northwest pasture of the Longleaf Tract, through the cooperation of the Louisiana Forestry Commission and the Kisatchie National Forest. An 85-foot well, pump, and engine have been installed on a grazing study area.

Severe damage from wildfire in 1952 necessitated clear-cutting 65 acres of slash pine planted 18 years ago.

Birmingham

The general improvement cut being applied to low-grade hardwoods in the Flat Top Experimental Forest removed 51 MBM of sawlogs and 22 M cubic feet of mine props in 1952. Cull trees on 160 acres were girdled.

Central Ozarks

An improvement cut was completed on 300 acres of the Sylamore Experimental Forest, and timber stand improvement was conducted on 620 acres. Because of a bad ice storm, about 120 MBM of shortleaf pine had to be salvaged. Improvement cutting and TSI were completed on 150 acres of study areas on the H. R. Koen Experimental Forest.

Crossett

Planned cuts completed on both units of the Crossett Experimental Forest during the past year amounted to 761 MBM of sawlogs, 1,045 cords of pulpwood, and 84 units of chemical wood. Logging was done by branch personnel under cooperative agreement with Crossett Lumber Company.

Delta

Improvement cutting on the Delta Experimental Forest covered about 480 acres. The total cut of 254 MBM was largely limited to poor-quality or damaged trees that were scattered through the stand (about 530 board feet per acre). Nevertheless, the cut returned a slight margin above cost and at the same time benefited the residual stand.

East Gulfcoast

The Chipola Forest was established in Calhoun County, Florida, in early 1952 in cooperation with the International Paper Company, the Hardaway Contracting Company, and the Florida Board of Forestry. A dwelling, water system, garage-office-warehouse, and an oil house are now nearly complete. Both companies and the Florida Forest Service have assisted in the construction of buildings, roads, and firebreaks, and in site-preparation for rather extensive planting experiments.

East Texas

A prefabricated steel garage-shop-warehouse is being erected on the Stephen F. Austin Experimental Forest. A weather instrument station has been installed to furnish data for the fire and infiltration studies. Construction of more than one-half mile of needed road was completed, and right-of-way has been cleared for an additional mile.

Gulfcoast

In the last 5 years on the 1,200-acre McNeill Experimental Forest, over 2,000 MBM of sawlogs, 800 cords of pulpwood, 4,800 poles, and 8,000 fenceposts have been harvested in improvement cuts and thinnings. During the same period on the 3,850-acre Harrison Experimental Forest (though little cutting was carried on during the first part of the period) over 750 MBM of sawlogs, 300 cords of pulpwood, and 20 cords of dogwood have been harvested, and about 26 M faces have been leased for naval stores.

Tallahatchie

All areas planted on the Tallahatchie Experimental Forest since 1947 were released from overhead competition where necessary. All non-restocking old fields and eroded areas were examined prior to a complete revision of the planting program. Most of the needed planting will be accomplished in the current year, in cooperation with the U. S. Forest Service Flood Control Project and the Holly Springs National Forest.

An extensive reconnaissance of the entire forest was completed preparatory to installation of large-scale studies concerned with rehabilitating and managing understocked, low-grade upland forests.

Location surveys for 2 miles of needed new road were completed, and all Experimental Forest boundaries and major interior corners were located, marked, or monumented.

COOPERATING AGENCIES

Bureau of Plant Industry, Soils and Agricultural Engineering

Tree diseases

A new branch office of the Division of Forest Pathology was established in cooperation with the Delta Branch of the Southern Forest Experiment Station at Stoneville, Mississippi, in July 1952. The work at this office will be confined to the study of diseases of hardwood trees throughout the South, but with particular emphasis on bottomland hardwoods. Some of the most important problems include heart rot in standing trees and sweetgum dieback.

Sweetgum dieback.--The gum dieback is characterized by a gradual dying of the affected tree, often from the top down. As yet little is known about the importance, prevalence, and cause of this condition. In order to follow the progress of the dieback, nine permanent plots have been established on which detailed notes were taken on the condition of all sweetgum trees. Numerous isolations from the tops of diseased trees have failed to yield fungi which might be suspected as contributing to the trouble. A number of sweetgum stands in Mississippi, Arkansas, and Alabama have been examined. Next year additional plots will be established, and isolations will be made from the roots of diseased trees.

Heart rot.--To obtain information that will improve prediction of heart rot from external indications, a study has been started in which a large number of individual trees will be carefully examined internally and externally. So far data have been gathered on 79 trees. Rot fungi have been isolated from about one-third of these trees. Many more trees--up to 1,000--will be examined next year.

Fusiform rust of southern pines.--Continued observations of the several plantings of "typical" slash pine from various geographic seed sources have failed to show consistent differences in susceptibility to fusiform rust. The Cuban slash, which showed early evidence of being highly susceptible, was all dead by the end of the second year in the field; most of the mortality was presumably caused by cold weather. Though survival has been poor, the "south Florida" slash pine still shows only a trace of infection. The identity of this variety as a slash pine is open to question, however.

After 2 years in the field, loblolly pine seedlings from 6 geographic seed sources showed a range of infection from 1. 5 percent for a North Carolina lot to 6. 4 percent for a Georgia lot. The planting will be followed to see if the differences are maintained.

Trials to determine if the seedlings from open-pollinated healthy trees are more resistant than those from cankered trees have yielded conflicting results. After 4 years in a south Mississippi plantation, two tests with slash pine seedlings from healthy parents in south Mississippi showed 12 and 17 percent infection, as compared with 32 and 28 percent respectively for seedlings from cankered parents. A corresponding test with Georgia slash pine in the same plantation showed 26 percent infection of seedlings from healthy parents and 12 percent infection of seedlings from cankered parents. Similarly, a test with Mississippi loblolly pine seedlings in the same plantation showed 40 percent infection of stock from healthy parents and 36 percent infection of stock from cankered parents. Thus it would appear that the mere choice of seedlings from a healthy maternal parent would be small guarantee of lessening the severity of fusiform rust.

A nursery spray experiment on slash pine, using various fungicides plus spreaders, again demonstrated that Ferbam plus Santomerse gave as good control as any of the materials tested. Seedlings from plots receiving this treatment showed 0. 2 percent infection as compared with 4. 3 percent infection in the untreated controls.

Arrangements have been made with the Forest Survey of the Southern Forest Experiment Station to record fusiform rust stem cankers on southern pines, and also the mortality of merchantable timber resulting from the rust.

Brown spot of longleaf pine. --Thirty 2-0 seedlings which gave evidence of resistance in heavily infected nursery plots were transplanted to the field in an area of high incidence of brown spot. Of the 18 seedlings surviving one year later, 5 had 30 percent or less of the current year's foliage dead from brown spot as compared with as much as 80 percent on adjacent seedlings originating from the same nursery plots.

Ascospores of the brown spot fungus, heretofore considered to occur in nature only in late winter and spring, were found throughout the summer on seedlings at the Harrison Experimental Forest.

Arrangements have been made with the Forest Survey of the Southern Forest Experiment Station to record brown spot of longleaf pine where 35 percent or more of the foliage is browned.

Nursery diseases.--A seed and seedbed chemical-treatment experiment aimed at improving the yield of plantable seedlings through controlling seed decay and damping-off was carried out at the W. W. Ashe Nursery. Four seed and seven soil treatments were used with longleaf and loblolly pines. Considering both species, the most successful treatment was a presowing application of 30 ml. of formaldehyde per square foot of seedbed, which gave an increase in plantable stock of 38 percent. The next best treatment was 3 grams of Zerlate per square foot of seedbed, applied before sowing and worked into the top 2-3 inches of soil; this gave an increase in plantable stock of 34 percent and appears worthy of further study.

Cooperation in the form of a personal visit was extended the Chittenden Nursery, Wellston, Michigan, in connection with a root rot disease of white pine.

New diseases and outbreaks.--Mortality of sapling loblolly in localized areas in the vicinity of State College, Mississippi, was investigated. The cause appears to be a root disorder of undefined nature.

A dying of seedling loblolly over areas of several thousand acres in south-central Mississippi was reported in late fall and winter. An examination of some of the areas in early January 1953 disclosed the primary cause to be drought, with needle fungi and bark-feeding insects as secondary factors.

Assistance, in the form of personal visits and surveys, was extended the Beltsville office in an evaluation of the oak wilt problem in West Virginia, Maryland, and Pennsylvania.

Decay in buildings and other structures

On-the-job preservative treatments.--Previous tests with southern pine wood exposed at Saucier, Mississippi, have shown the value of dips and short-period soaks of exterior woodwork. To broaden the scope of this work, an extensive test has been established with exposures in Oregon, Wisconsin, and Mississippi. Woods under test are southern pine, Douglas-fir, Western hemlock, white fir, Western redcedar, and ponderosa pine made up into 2 x 2-foot porch flooring panels and the simulated step rail-to-newel unit. This test should yield considerable information on the effects of geographical region and wood species on the efficiency of on-the-job applications of preservatives and the relative decay rate of the main building woods in the 3 regions.

Siding studies.--Few readings were taken on the experimental siding panels because of extremely dry weather during much of the year. A technical paper was prepared on the results of past readings.

Fungi on treated wood.--Samples of wood treated by the U. S. Forest Products Laboratory were put into soil burial tests at Saucier for periodic isolations to determine what fungi cause failures of different preservative treatments. This project should eventually give a sound basis for recommending suitable test fungi for laboratory toxicity tests.

Protection of ammunition boxes.--Under a contract with the Army Ordnance Corps, extensive tests were started to determine the feasibility of using wood preservatives to protect ammunition boxes during outdoor storage. The main test was established. It includes more than 2,500 small arms boxes treated with a large variety and several concentrations of fungicides and exposed under varied conditions at Saucier, Mississippi; Canal Zone, R. P.; and Madison, Wisconsin. A series of supplementary tests was started in which such factors as wood species and fungus infections can be more accurately assessed by using matched test units simulating boxes.

Mold occurrence and effects on wood

Two-foot sections of molded southern pine posts soaked in 5 percent pentachlorophenol in crude oil showed heavier bleeding during the first year of exposure than did treated unmolded samples. In the second year, several stakes are showing decay. This test was complicated by the use of end coatings prior to treatment, but it still suggests that the use of molds to prepare wood for preservative treatment may be risky. Further tests have been started.

Preliminary tests show that the high water absorbency of molded wood can be greatly reduced by treatment with toxic moisture repellents. Even though the efficiency of such treatments does not appear to be as high on molded as on uninfected wood, moisture repellents apparently could be profitably used on any infected wood that must be exposed to rain.

The antibiotic effects of artificially induced heavy infections of *Trichoderma* still promise to be effective in preventing rot in pine pulpwood stored for periods up to 6 months. Tests with more than 30 isolates of *Lenzites saepiaria*, an important decayer of pine lumber in use and of older stored pulpwood, showed that this species is not inhibited by the mold *Trichoderma*. In fact, more decay usually occurred when the mold was present. Thus it appears that the biological control of wood rots will be complicated by specificities similar to those found in the medical field.

Deterioration of stored pulpwood and logs

In a small test with water oak and red oak bolts, several end coatings were more effective than filled hardened glass oil in preventing water loss and consequent end checking. Among the best coatings were an asphalt-asbestos-oil mixture and two Saran latex products adjusted to brushing consistency. Further tests are definitely in order.

Additional observations were made on the extent of deterioration in pulpwood (cut during the summer, winter, and spring) during 4 and 6 months of storage. Sweetgum as well as pine was used. Although the data are not yet fully analysed, it was quite obvious that much less decay occurred during storage in this near-drought year than in previous tests. Rough sweetgum bolts decayed somewhat more than rough pine bolts.

Bureau of Entomology and Plant Quarantine

Southern pine beetle--epidemic in Mississippi, dies out in Texas

During the last week of May 1952, a severe infestation of the southern pine beetle was discovered in southwest Mississippi in an area in which the trees had suffered heavy sleet damage in 1950. Immediate control measures were put into effect by the Federal and private landowners in the area. The Mississippi State Forest Service assisted in coordinating the control efforts of the smaller timberland owners. Surveys were conducted and technical advice in control was given by the Gulfport laboratory of the Division of Forest Insect Investigations. The control methods consist of cutting and removing those trees that harbor broods of the beetle and utilizing them as rapidly as possible for lumber or pulpwood. The maturing beetle broods are destroyed by burning the lumber slabs and bark at the mills. In many cases where handling the infested timber is not commercially feasible, the brood trees are felled and sprayed with .25 percent benzene hexachloride in fuel oil. Despite the very heavy populations of beetles in this area, the prompt control measures have held the loss of timber to only about 30 million board feet.

During the summer, the infested timber occurred in spots from one-half to 30 acres in size. These spots were readily seen during aerial surveys and were likewise comparatively easy to find on the ground. In the late fall the beetles characteristically scattered into single trees or to small groups of 1 to 5 trees. In this scattering the beetle was assisted greatly by a very severe drought and by associated Ips attacks. The small groups are largely inoperable and are hard to detect and plot accurately from an airplane, necessitating the use of intensified ground reconnaissance and very mobile spray units.

At year's end, concerted efforts were being made by all agencies to reduce the beetle population to where the early flights during the spring months can be readily combated during the first life cycle of the beetles. Since the beginning of the control program in June, Forest Pest Act funds have provided the major portion of the expenses for both control and survey programs of the U. S. Forest Service and the Mississippi State Forest Service in cooperation with private interests.

In eastern Texas no evidence of the southern pine beetle has been found since last January, when a few broods were observed in association with engraver beetles in the tops of felled trees. No research was conducted in Texas on this project during the year, but frequent ground checks were made of old beetle-killed areas, cutover areas, and storm-damaged areas in an unsuccessful attempt to locate this insect under normal conditions.

Black turpentine beetle is still killing pines

The black turpentine beetle, which has since 1949 spread its tree-killing activities throughout the Lower South, continues as a serious problem. In recognition of this fact a small research unit was established in northern Florida, where the beetle is particularly important and acute. Studies in Mississippi, where the problem exhibits different characteristics, were temporarily closed this season because of personnel shortages. In Texas, where local differences in the problem also exist, studies have been continued on a small scale.

In Florida the beetle continues to cause scattered light losses over an extensive area and heavy losses on localized small areas. Its destruction is almost exclusively limited to slash pine growing on the pond sites, usually in conjunction with naval stores operations. Three factors which appear to be most responsible for the present situation are drought, naval stores practices, and logging operations. Any immediate control will, more than likely, have to be directed toward the last factor, though long-time measures may very well rest with changes in naval stores practices. Salvage cuttings, sweetened with near-by green trees, usually intensify and broaden the destructive activity of the insect by providing additional stumps in which the beetle can breed and increase in numbers.

Current biological studies in Florida reveal that the insect may be found in all developmental stages at most seasons. This is both because of an over-lapping of generations, which are a little more than three months in length, and because of the variation in rate of development within a generation. The size of the initial egg group is much larger than anticipated, varying from 70 to 280, with an average of about 150. Egg viability is about 85 percent. In Florida 98 percent of the attacks are made below a height of 6 feet, and 86 percent are below 3 feet. The percentage of attacks above a given height varies directly with the diameters of the trees attacked. The first trees to be attacked on an area are, with very few exceptions, those which have been faced for naval stores.

The control procedure as currently practiced by the Osceola National Forest is probably one means of suppression. It consists of clear-cutting infested stands, leaving only seed trees. All stumps, as well as the basal 8 feet of the seed trees, are sprayed with a .5 percent solution of gamma BHC (benzene hexachloride in Diesel oil). Because it removes a large amount of the growing stock, such a procedure does not seem applicable to a small landowner. However, stump treatment carried out in connection with true salvage cuts when mortality is still low does seem economically sound.

In stump-treating tests, the addition of auxiliary oils does not measurably improve the control or preventive action of the basic .5 percent gamma BHC in Diesel oil. Aqueous preparations of the same concentration are noticeably inferior to the oil solution.

Stump-treating tests in Mississippi reveal that, when chemicals are applied almost immediately after the trees are cut, breeding of the beetle may be prevented. By the time the insecticide loses its power to kill attacking beetles, the stump loses its attractiveness as breeding material. A 10 percent dust, and .25 and .5 percent concentrations of gamma BHC in oil continue to give best results. One large timber industry which for several years has annually lost up to 5 million board feet of timber to the turpentine beetle has reduced the beetle to negligible status by application of an intensive control program; spraying of stumps and butts of attacked and susceptible trees with BHC in oil played a primary part in control.

In Texas, case history studies of 80 beetle-infested merchantable loblolly pines reveal little mortality since last spring, when study plots were established. Losses were much less than with longleaf pine of comparable size in Mississippi. Whether the trees will recover or whether mortality will be slow but certain (as sometimes occurred in Mississippi) remains to be seen.

Sawflies continue to menace pine stands from Texas to Alabama

During the years 1940 through 1950, the loblolly pine sawfly defoliated and caused serious growth loss in pine stands over several millions of acres in south Arkansas. In 1949 it was found in epidemic status in north-central Louisiana. A successful airplane spray control program using DDT in oil was carried on against it near Urania, Louisiana, in 1950.

In 1951 it rose to near epidemic status near Colfax, Louisiana, in the central part of the State. Tentative plans are being made, in cooperation with timber managing agencies, to conduct control measures in this area in the spring of 1953 if early observations indicate an impending heavy sawfly population.

In September 1952, a species of sawfly similar to one previously collected in east Texas and north Mississippi was found in local epidemic status near Camden, Alabama. It had severely defoliated the pine stands, particularly those containing shortleaf pine, scattered over an area of about 100,000 acres. From preliminary observations, it appears that this sawfly has 2 and perhaps 3 generations a year, with the heaviest feeding being done in late fall. Such defoliation lowers the vigor of individual trees so much that they often succumb to tree-killing bark beetles. Observations are to be continued on this sawfly so that land-managing agencies may be advised of its status; assistance will be given in the event that control measures are advisable.

New insecticides protect against powder-post beetles

Powder-post beetles, particularly Lyctus, are a serious problem in stored hardwood products such as implement handles, pallets, and lumber. For years, dipping in pentachlorophenol, sulphur, and borax have been recommended for control, but each of these chemicals has certain limitations. In 1948 studies were begun to determine how long these chemicals prevent attack and to test new insecticides. The results show that DDT, benzene hexachloride, chlordane, and other new insecticides will prevent attack by Lyctus for a period of over four years.

These recently developed insecticides are superior in effectiveness to those formerly used and do not possess the limitations of the old ones.

Preliminary studies have shown that an aerosol application of DDT gives some control of Lyctus in stored wood products. Investigations are in progress to determine the effectiveness, both as a remedy and as a preventive measure, of repeated aerosol applications. If perfected, this method of treatment will eliminate handling costs and result in a substantial saving.

Preservative treatment of green trees still effective after 17 years

Termites and decay are serious problems in fence posts and other untreated wood in contact with the ground. In 1933 investigations were begun in an attempt to develop an effective and economical method of injecting preservatives into living trees. Sections of treated trees were placed in service tests at Asheville, North Carolina; Santee, South Carolina; and Saucier, Mississippi. After 17-1/2 years in the soil about 50 percent of the sections are still serviceable as fence posts. These sections had been treated by the "stepping" method[1/] in the spring of the year, using 1-1/2 pounds of copper sulphate, 1-3/4 pounds of zinc chloride, and 1/2 pound of sodium arsenite per cubic foot of wood. Sections treated with mercuric chloride and sodium arsenite, each at the rate of 1-1/2 pounds per cubic foot, were 75 percent to 80 percent serviceable after 17-1/2 years' exposure.

Treatments made during late summer and early fall were much less effective than those made in the spring.

Protecting logs from boring insects

Tests conducted during recent years in cooperation with lumber operators in southern States have shown that a concentration of 1-3/4 pounds of the gamma isomer of benzene hexachloride in 50 gallons of No. 2 fuel oil will protect logs against attack by wood-boring insects. The period of protection lasts up to 4 months, even during the season of heaviest insect activity, when it is a common practice to store logs for winter use. Research during 1952 was directed toward increasing the duration of effectiveness, and reducing the cost of treatment. In these tests the addition of crude tall oil to the fuel oil solution did not increase

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[1/] In applying the "stepping" method the tree is sawed at the base and leaned against a standing tree; the severed end is then immediately moved into a container of the preservative.

the effectiveness of benzene hexachloride, nor did thickeners and stickers improve the effect of emulsions and suspensions. A concentration of 1-3/4 pounds of gamma isomer of benzene hexachloride per 50 gallons of No. 2 fuel oil was superior to similar concentrations of emulsions and suspensions. An emulsion containing 3-1/2 pounds of gamma per 50 gallons was about as effective, but also as expensive, as the oil solution. However, its use may have advantages where transportation of oil is a problem. Heptachlor, 5 percent, in No. 2 fuel oil was as effective as the oil solution of benzene hexachloride.

Termite prevention in slab-type construction

The increased use of the concrete floor slab for both homes and commercial buildings has thrown emphasis on certain aspects of termite prevention. Numerous instances of termites penetrating slabs at expansion joints, at plumbing openings, and through cracks, together with the difficulty of combating such infestations after construction is completed, indicate the need for a joint and crack filler that will resist termites. Many fillers are inadequate because they permit direct penetration, or develop cracks through which termites can pass. Sealing compounds are being evaluated in laboratory tests for resistance to termite penetration. To date, four materials--Sealz, RR-1950, coal-tar pitch, and asphalt AC-5--have all prevented termite penetration in laboratory tests for 1 year or longer. RR-1950, which is still effective after 15 months, is most promising.

New soil poisons for subterranean termites

The search for the most effective and economical soil poisons to prevent termite entry into buildings continues. Many new formulations are under test in both Mississippi and the Canal Zone.

DDT and benzene hexachloride are superior to other poisons commonly recommended in the past. In Mississippi, 8 percent DDT in fuel oil is still effective 8 years after treatment, while benzene hexachloride (0. 8 percent gamma isomer) in kerosene continues to give complete protection 6 years after treatment. More recently established tests with chlordane, dieldrin, and aldrin show considerable promise, and most formulations are giving complete protection 4 years after treatment. Further testing is needed to show which formulation and dosage is best.

DDT, benzene hexachloride, chlordane, and dieldrin are being tested in buildings, where, because of less severe conditions, they may be expected to exceed their field-test performance. The building tests include soil poisons applied both in trenches along foundation walls and on the surface of earth fills before concrete slabs are poured. The prospects are very good that most of these treatments will give long-time protection (probably 10 years or more) from termite damage. The promising treatments discussed above have been established in the Canal Zone but have not been in service long enough for results to be significant.

A principal obstacle to the use of many of these new soil poisons is ignorance of their toxicity to ornamental plants that may be growing near the poisoned areas. The past year's research suggests that formulations may be developed that can be applied very close to such plants.

Preliminary studies have also been made of the distribution of soil poisons when sprayed through holes in existing slabs. Results showed that with a sprayer pressure of 50 pounds per square inch it is possible to treat the soil satisfactorily at distances of 3 to 4 feet from the spray nozzle under slabs having voids of 2 to 4 inches underneath. With voids of one inch a spread of 2 feet from the nozzle was the maximum. A nozzle that delivered a fan-shaped spray of 180 degrees gave the best distribution. In actual practice it is doubtful whether consistently good treatment of the soil could be obtained at the distances indicated,because the soil under slabs is often very uneven. Further research to determine the proper spacing of holes through the slabs and the best type of equipment is planned.

Preservation of wallboard, fabrics, and othe cellulose products

Untreated wallboard and insulation panels of wood pulp or agricultural waste products are very susceptible to termites. Since 1948 various of these products--some of which had been treated by the manufacturer against termites and some of which were untreated--have been under test in Mississippi. Many of the untreated materials were given 10-second dip treatments to determine the effectiveness of various chemicals in preventing attack.

Samples treated with 10 percent sodium arsenite and 2 percent copper naphthenate have held up well in direct contact with the soil for four years, with slight attack by termites and decay. A solution of 5 percent pentachlorophenol was somewhat less effective. Samples having pentachlorophenol incorporated during manufacture have also been damaged to some extent. Untreated samples were heavily damaged within one year.

Sandbags, cloth, cordage, and other fabrics treated with various preservatives are being field-tested to determine how long they will resist termites and decay. Cotton fabrics impregnated with copper naphthenate or copper 8-quinolinolate and placed in direct contact with the soil are still serviceable after 1 year of exposure. Other preservatives in this test(which is being conducted in cooperation with the Southern Regional Textile Laboratory, New Orleans) failed to attain this degree of protection.

Conduits made of used paper pulp and impregnated with coal-tar pitch by the manufacturer were placed in soil-burial field tests in Mississippi and in the Canal Zone in 1946. The pitch-impregnated samples show no evidence of attack by either termites or decay after 6 years in the soil. Samples not impregnated with pitch were severely damaged within a year or two.

Plastic cable penetrated by termites

Termites quite often penetrate underground cables and cause short circuits in electric currents. In 1949 Bell Telephone Laboratories submitted samples of various materials which were placed in service tests in Mississippi. Alpeth cable buried in soil has resisted termites for approximately 3-1/2 years. Two polyethylene compounds have been damaged by termites.

Surface treatments with insecticides protect wood

A large number of formulations are being tested to determine their value as surface treatments of wood to protect it against termites. These studies are being made at the request of and in cooperation with the Corps of Engineers, U. S. Army, which is confronted with the problem of protecting its buildings, tent platforms, crating, ammunition boxes, and tool handles. Many commonly accepted preservatives are not physically adequate for such use; others have never been fully evaluated; and still others require special impregnation processes. The purpose of the test is to evaluate available chemicals and test new insecticides when applied as cold solutions by immersion or brush treatment. These tests were begun in Mississippi about 8 years ago, and quite recently many have been duplicated in the Canal Zone.

New chlorinated hydrocarbon insecticides such as benzene hexachloride and DDT, when combined with a good fungicide and applied as a 3-minute dip, are giving good protection against termites and decay after 3 years of direct contact with soil in Mississippi. Similar performance appears likely in the Canal Zone, but there the period of service has not been long enough to yield significant results. However, breakdown of materials is much more rapid, and there is little doubt that immersions in excess of 3 minutes will be the effective ones.

About 8 years ago a test of preservatives was established in cooperation with the Defense Department. One-inch thick stakes dipped for 3 minutes received almost complete impregnation. Current examinations reveal 70 percent serviceability of copper naphthenate (2 percent copper) treatment; this is considerably above the performance of the 5 percent pentachlorophenol that is being used in the same test. Addition of 5 percent DDT improved pentachlorophenol performance. A 2 percent copper pentachlorophenate treatment gave very good results.

Drywood termite control in Canal Zone

Recently developed treatments, while far from being perfect, are displacing old materials and methods in the drywood termite control programs of the armed forces in the Canal Zone. Until the recent establishment at Fort Clayton, Canal Zone, of a branch station of the Forest Insect Laboratory of Gulfport, the accepted practice was to treat infestations with insecticide dusts applied with hand guns. Results were erratic and failed to protect the wood against subsequent attack. However, the promising performance of new chlorinated hydrocarbon insecticides has resulted in their early adoption by Navy and Army control units. Two percent chlordane in trichlorobenzene is being applied to infested wood by spraying, brushing, or injection with conventional sprayers modified to fit various application requirements. Benzene hexachloride and DDT in trichlorobenzene have also shown considerable promise. A search is being made for a carrier less objectionable to handle then trichlorobenzene.

RESEARCH PLANNED FOR 1953

FOREST MANAGEMENT

Alexandria

Direct seeding of longleaf pine will be continued on a large scale, and spring sowing on disked strips will be tested. Particular emphasis will be given to finding an effective bird repellent. The U. S. Fish and Wildlife Service is cooperating in this work.

Longleaf direct-seeding work at the Alexandria Branch will be summarized for publication. In addition, an article covering all longleaf direct-seeding trials in the South will be prepared in collaboration with Region 8 of the U. S. Forest Service.

The techniques of direct seeding of loblolly pine will be further investigated, and exploratory tests of direct seeding of slash pine will be initiated.

Krilium, a new soil conditioner, will be tested at the Stuart Forest Tree Nursery, where a serious crusting of the topsoil has developed.

Publications will be prepared on studies of longleaf pine height growth, thinning variously spaced loblolly pine plantations, pine underplantings, and mixed loblolly-slash plantations.

Birmingham

Exploratory work will be started on the use of prescribed burning for hardwood control and seedbed preparation in the pine-hardwood type of northern Alabama.

The amount and distribution of pine reproduction will be studied on several areas which have received stand improvement work over the past several years.

A proposed Farmers' Bulletin superseding the old Longleaf Pine Primer should be ready for publication by the end of 1953.

Central Ozarks

A report will be completed on the classification of forest sites in the Arkansas Ozarks. The classification system is based on soils, geology, and topography.

The geographic sources of shortleaf pine seed will be compared in a study that is part of the South-wide test of geographic seed sources being made by the Southern Forest Tree Improvement Committee.

The entire program of the Central Ozarks Branch is being reviewed and will be revised where conditions warrant.

Crossett

Several genetic studies will be initiated in 1953. These will include geographic races, graded nursery stock, location of "plus" tree candidates for use in selection studies, and beginning of hybridization studies. To facilitate this work a small-scale nursery and fenced genetic testing area is being developed. This work is being done cooperatively with the Crossett Lumber Company.

Because of the probable difficulties in securing natural regeneration under short-rotation, even-aged systems of management, tests will be made of various methods of artificial regeneration following clear-cutting. Planting, and direct seeding with and without burning for site preparation, will be tried on an exploratory basis.

An integrated analysis will be made of all direct-seeding studies that have been made on upland sites dominated by relatively large overstory hardwoods. In addition, the Crossett Branch will cooperate with the Southern Lumber Company of Warren, Arkansas, to assess the results of aerial seeding of a 4,500-acre tract badly damaged by wildfire.

Studies on the influence of season of application on the effectiveness of hardwood poisoning with 2,4-D and 2,4,5-T are being continued.

A problem analysis for research in soil-site relationships and management of forest soils in the Crossett area has been completed. The first studies on problems delineated by the analysis will be started this year. These forest-soils investigations are being made with the cooperation of the Southern Lumber Company of Warren, Arkansas, and the Murphy Corporation of Eldorado, Arkansas.

Delta

Information is needed on the growth of hardwood stands in the lower Mississippi Valley and adjacent areas. The Southern Hardwood Forestry Group (composed of representatives of Federal, State, and private agencies) hopes to obtain such information by means of approximately 1,000 permanent growth plots that are now being established. Growth and mortality data to be taken from these plots over a period of years will be analyzed by broad forest types, stand classes, and geological sites. The Delta Branch will serve in the planning, training, coordinating, and analysis phases of the work.

A small-scale test will be made of the use of various growth hormones in the rooting of cottonwood, mulberry, green ash, and dawn redwood (Metasequoia glyptostroboides) cuttings.

East Gulfcoast

Most of the new work at the East Gulfcoast Branch will be aimed at converting scrub oak stands to pine on the sandhills of west Florida. The main installation planned will compare different intensities and techniques of site preparation prior to planting various southern pines. Competition will be reduced to several levels varying from a simple prescribed burn to the creating of "old field" conditions. The effect of these site treatments on the survival and growth of the pines will be evaluated.

The use of CMU for killing scrub oaks will be investigated further. CMU in large dosages kills almost all vegetation on an area. What is not known is the minimum rate of application that provides a satisfactory kill and the length of time treated areas remain toxic to planted pines. These problems will be explored on both the Escambia and Chipola Experimental Forests.

Other phases of the sand hills regeneration investigations will involve tests of early season planting; the effect of root length on survival; planting techniques; tests of mulching and fertilization; and the clipping and dipping of longleaf foliage prior to planting. The survival and growth of seedlings produced on various nursery soils will also be studied, as will the effects of geographic sources of longleaf and sand pine seed.

On the Escambia Experimental Forest, work will be continued on established studies. The only new work contemplated is the previously mentioned test of CMU and a study of the geographic source of longleaf pine seed.

East Texas

The effects of prescribed burning on certain soil-water relationships will be investigated in studies recently started near Nacogdoches, Texas. Infiltration capacity and rate, soil moisture at several depths, run-off, and surface soil movement will be compared with and without prescribed burns on three different soil types. It is hoped that these data will fill some of the gaps existing between the known benefits of prescribed burning and the potential but unevaluated detriments.

In another study, degree of crown scorch will be evaluated as a criterion for predicting mortality of fire-damaged loblolly and shortleaf pine of sawlog size. This work will be carried on in cooperation with the Texas National Forests.

Gulfcoast

New studies planned at the Gulfcoast Research Center will include a test of the application of various hormones for the stimulation of pine seed production, a study of the use of herbicides in longleaf pine seedbed preparation, and the effect of liming on the growth and brown-spot resistance of longleaf pine seedlings. Also contemplated are a study of presowing applications of chemicals to control weeds in forest nurseries, and further work in the use of foliage coatings to reduce mortality of planted pines.

Hybrid pine seedlings resulting from last year's controlled pollination work will be raised in the Harrison Nursery. Some additional controlled pollinations will be made.

Tallahatchie

Studies on improvement or rehabilitation of north Mississippi's depleted upland hardwood forests will be continued and expanded if funds permit.

The Tallahatchie Branch will participate in the work of the Committee on Southern Forest Tree Improvement by making test plantings of shortleaf pine from several widely separated geographic seed sources.

If possible, a soils specialist will be added to the staff to resume work in the soil stabilization phases of forest influences research.

Vicksburg Infiltration Project

Studies will be made of soil-moisture relationships, methods of predicting soil moisture, and soil trafficability at five new locations. The areas being considered for study are Albuquerque, New Mexico; Spokane, Washington; Rhinelander, Wisconsin, Fort Collins, Colorado; and Crossett, Arkansas.

Plans call for publication of papers on soil-moisture prediction, soil-moisture measurement with fiberglas instrument, factors affecting the determination of bulk density in soils, a review of the literature on evapo-transpiration, physical properties of 13 Mississippi soils, root concentration in soils under hardwood and herbaceous cover, infiltration rates as influenced by antecedent soil moisture, and soil moisture regime of several soils as affected by climate, vegetation, and soil characteristics.

FOREST ECONOMICS

Forest Survey

Timber Resource Review.--In 1953, demands of the Timber Resource Review for current estimates on forest area, timber volumes, growth, mortality, drain, and waste utilization will have first priority. Estimates by States and Timber Resource Review regions will be required for the entire Station territory.

Alabama.--So much cooperative assistance is being received from the Division of Forestry of the Alabama Department of Conservation, and from pulp companies and other members of the Alabama Forest Products Association, that it is expected that field work for the Alabama reinventory will be completed in March 1953. Compilation will be finished for the Timber Resource Review, and a Forest Survey statistical report will be published for the entire State.

Compilation of 1951 forest industry and drain data will be completed.

Arkansas.--A State statistical report on the 1948-1951 survey will be published early in the year. Work will be initiated on the State analytical report. Survey findings will be brought up-to-date by office estimate for the Timber Resource Review.

Louisiana.--With cooperative assistance from the Louisiana Forestry Commission, pulp companies, and others, field work for a representative group of parishes can probably be completed in time to provide a basis for Timber Resource Review estimates of inventory and growth. Sampling in pine parishes will be intensified to give estimates of ± 10 percent sampling error for total cubic volume in individual parishes. Sampling in the Delta will be on a regular 3- by 3-mile spacing of locations. It is expected that all field work for the reinventory will be completed late in 1953.

Mississippi.--Estimates of the 1946-1948 resurvey will be brought up-to-date by office estimate for the Timber Resource Review.

Oklahoma.--Field sampling on an extensive basis for the Timber Resource Review will be undertaken in cooperation with the State forestry organization.

Tennessee.--A review draft of a State analytical report will be completed. The 1948-1950 inventory will be brought up-to-date by office estimate for the Timber Resource Review.

Texas.--With cooperative assistance from the Texas Forest Service, field work in a representative group of counties will be completed and estimates made for the Timber Resource Review. The regularly scheduled reinventory is expected to be completed early in 1955, several years ahead of previous plans.

Pulpwood production.--Annual pulpwood production statistics for the South will again be obtained in cooperation with the Southeastern Forest Experiment Station and the Southern Pulpwood Conservation Association. The report on 1952 production will be published by the Southern Station.

Economics of Forest Management

Guides to profitable forest management.--The study of financial maturity of loblolly and shortleaf pine in southern Arkansas will be published as an Occasional Paper.

Also due for release are results to date and some predictions as to future yields and incomes for the study of financial aspects of all-aged versus even-aged management of loblolly and shortleaf pine. This study is being conducted in cooperation with the International Paper Company.

An outline and part of the text of a technical bulletin covering the use of financial maturity as a guide to profitable forest management will be prepared.

Returns from well-managed commercial forests.--Costs and returns will be reported from:

> 1,000 acres of second-growth loblolly and shortleaf pine-hardwoods managed under the selection system at the Crossett Research Center.
>
> 641 acres of second-growth longleaf pine managed under group cutting at the East Gulfcoast Research Center.

2,500 acres of second-growth upland hardwoods and shortleaf pine recently covered by an improvement cutting at the Central Ozarks Research Center.

Returns from well-managed small tracts.--Studies of financial possibilities of small woodlands will be continued at eight research centers during 1953. An Occasional Paper will be issued on the results of 15 years of management of the "good" and "poor" farm forties at the Crossett Branch. Reports covering the first five years of management of farm forties at the Birmingham, East Gulfcoast, East Texas, and Gulfcoast Branches will be published.

RANGE RESEARCH

Alexandria

Grazing management.--In the study of yearlong versus seasonal grazing, records will be intensified to obtain more complete information on beef cattle production, costs, and income. The study of grazing and burning on slender bluestem range will be continued with intensified records of cattle utilization to determine actual weight consumption of native range grasses by beef cattle.

The controlled hog-damage study will be continued according to plan. The slash pine trees are getting larger roots and may be damaged next season. A new study is planned to test whether prescribed burning can be used to reduce hog damage to slash pine.

Control of undesirable hardwoods.--Results from the 3-year study of new chemicals and methods for controlling scrub oaks will be written into a final office report. The best chemicals will be tested on plots large enough to provide good cost data and also to serve as demonstration areas. A plan will be prepared for a small study in which carefully selected new herbicides will be compared, by standard methods, to the most effective chemicals tested so far.

Artificial revegetation.--The present site for nursery testing of forage plants is on rather dry sandy soil. A new site will be selected on land not so completely drained. About 20 species of grasses and legumes will be seeded during March and others in October.

Firebreaks will be established according to the best treatments from past studies. They will be laid out across one of the experimental ranges and will be designed to tie into a study of grazing distribution.

Central Ozarks

A final office report will summarize six years of data on the forage production of Ozark woodlands. The study of deer browse on the Sylamore Forest will be transferred to the Arkansas Fish and Game Commission, unless financing can be found to carry out the Southern Forest Experiment Station's part.

East Gulfcoast

Studies of forage production and of cattle returns from forest range will be continued on the Escambia Experimental Forest in south Alabama.

Collection of samples of wiregrass forage will be continued on the Chipola Experimental Forest in west Florida, for chemical analysis of nutritive values by the University of Florida. Actual grazing studies on the Chipola are deferred until the major forest regeneration and management studies are more fully under way.

East Texas

The cooperative aid study of forest grazing in the loblolly-shortleaf pine-hardwood type will be planned and initiated. Tentative plans call for a survey of forest grazing in selected east Texas counties by a research staff employee of the Texas Forest Service, in cooperation with the Southern Forest Experiment Station and the Texas Agricultural Experiment Station.

Gulfcoast

Grazing on the McNeill Experimental Forest, as handled in the past (purchasing steers in spring and selling them in fall), has been profitable in only one out of three years of study. Negotiations are under way to work out a mutually satisfactory arrangement with the Mississippi Agricultural Experiment Station for continuing the study.

The big trefoil firebreak will be burned in the winter 1952-1953 to remove litter and grass and to test the effect of burning on the trefoil.

New Orleans

Work will continue on methods of forage inventory in cooperation with Region 8. A field training session is scheduled for rangers on the Ouachita National Forest in west-central Arkansas and eastern Oklahoma.

FOREST UTILIZATION SERVICE

The Forest Utilization Service will continue to furnish advice and guidance to industry on the utilization of sawmill waste for pulp chips. Greater emphasis will be placed on waste from the soft-textured hardwoods and from the smaller sawmills. This will involve research on the development and performance of new types of log barkers and waste chippers.

Cooperative log-grade and mill-scale studies are planned with the U. S. Forest Products Laboratory, the Southeastern Forest Experiment Station, Region 8, and industry. The studies will investigate the grade and volume of lumber produced from hardwood logs graded by the Forest Service standard log grades for both sawlogs and tie-and-timber logs. Similar studies will be made to evaluate the proposed log grades for southern pine. Grade-yield studies looking toward the development of standard hardwood veneer-log grades will also be undertaken.

A cooperative project will be initiated with the Forest Products Laboratory, the Southeastern Station, and Region 8 on the development of tree classes and tree grades for southern pine.

Work in the preservative treatment of fence posts will be continued in cooperation with the Forest Products Laboratory, the Tennessee Valley Authority, and State agricultural experiment stations. Efforts will be concentrated on inexpensive methods of treating wood to be used for construction, particularly on the farm.

The Forest Utilization Service will cooperate with the Forest Products Laboratory in completing the study of strength and related properties of second-growth southern yellow pine. Additional samples of longleaf and slash pine from different regions are needed.

Cooperative work with the Forest Products Laboratory and State forestry schools will be continued with the object of determining the factors that affect the specific gravity of southern pine and the application of the findings to forest management.

The loss and waste of wood products from improper air- and kiln-seasoning remains one of our greatest problems. The Forest Utilization Service will continue to work with industry on improving seasoning practices. Efforts will be directed especially towards convincing management of the need for and value of reducing loss from degrade and waste.

In order to keep abreast of current developments in its field, the Forest Utilization Service will continue to maintain close contact with research agencies and with the industries that produce and use wood. It will also attend and participate in meetings of interested groups in order to acquaint industry and the general public with the results of research and to encourage and assist in the application of new techniques.

FLOOD CONTROL SURVEYS

The survey program is now largely geared to meeting the needs of the Arkansas-White-Red River Basin Interagency study. Survey findings for the White and Ouachita River watersheds will be strengthened by additional study and modified where necessary. Much of the Station effort will go into AWR task force participation to enable appropriate coordination of survey data and proposals.

Also scheduled: (1) completion of the forestry phase of the Sabine-Neches survey; (2) resumption of the Hatchie-Loosahatchie-Wolf River survey; and (3) continuation of the Cumberland River Basin study on an expanded scale.

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